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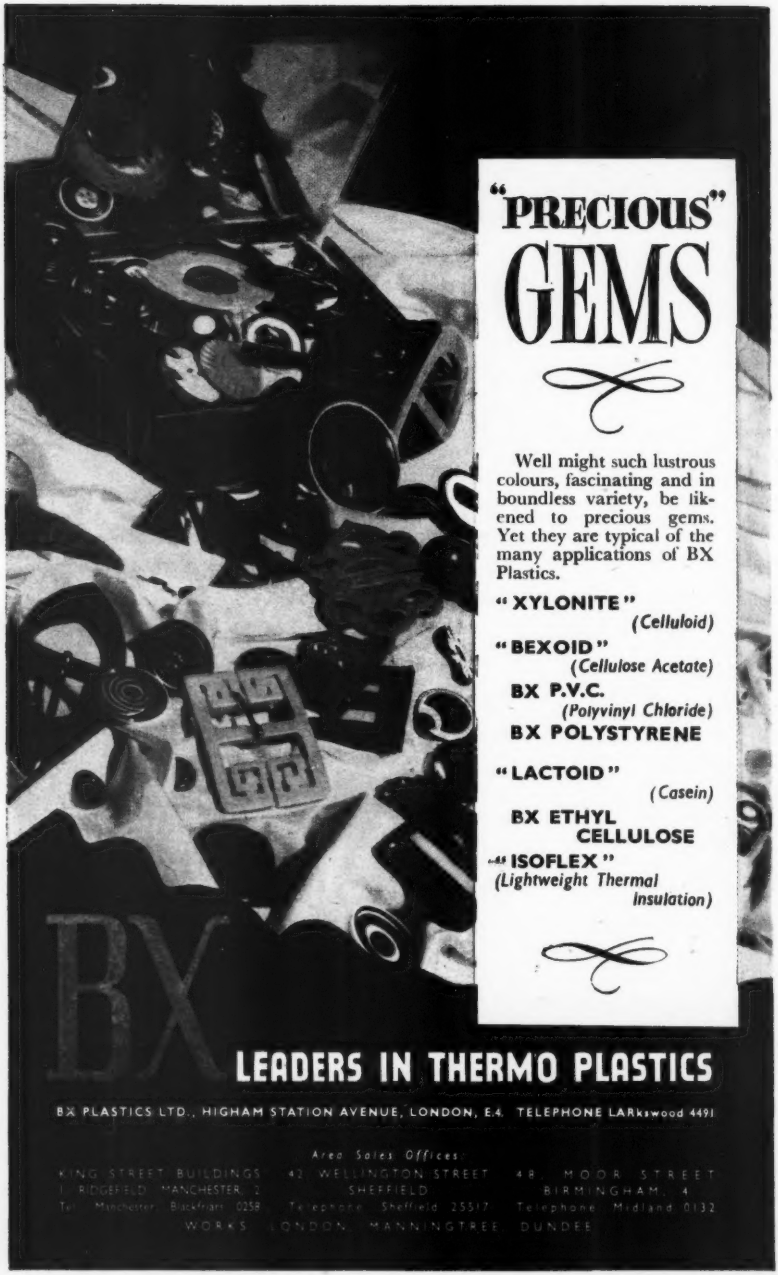
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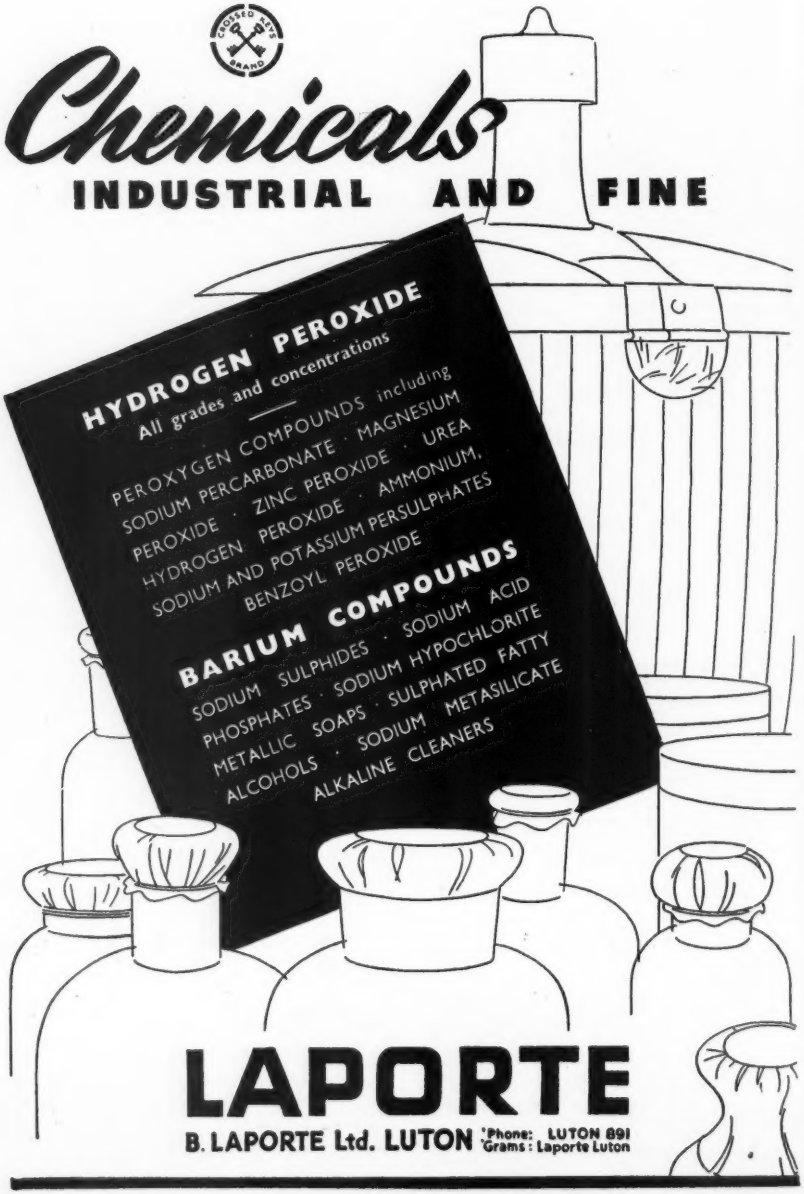

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471/P117

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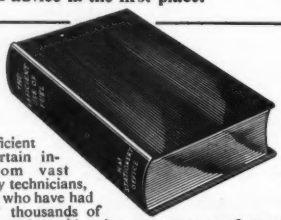

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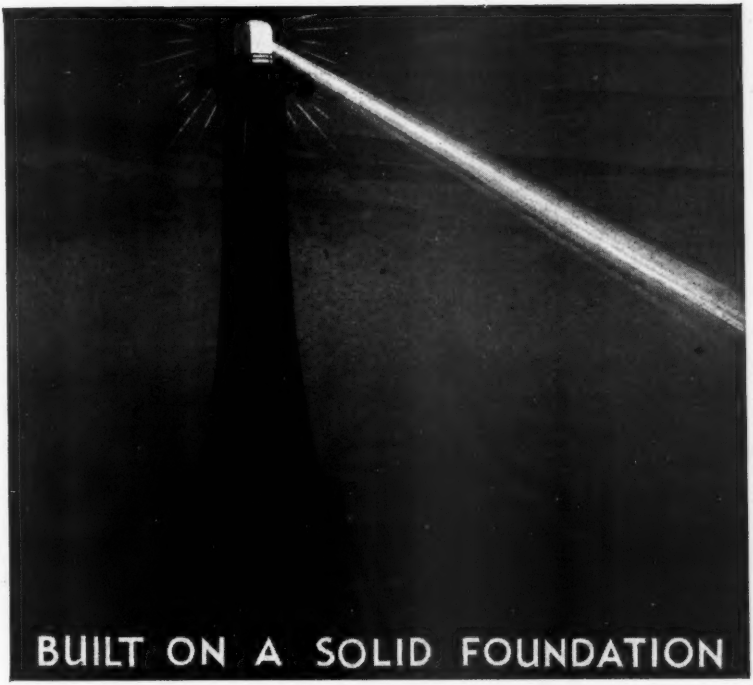

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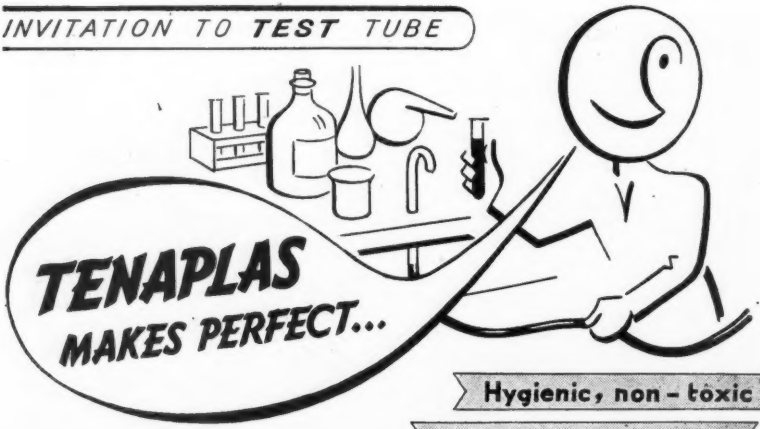

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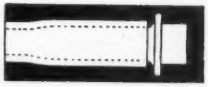

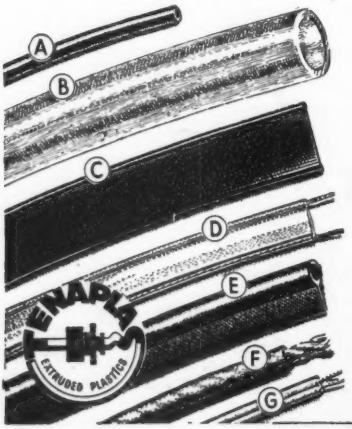

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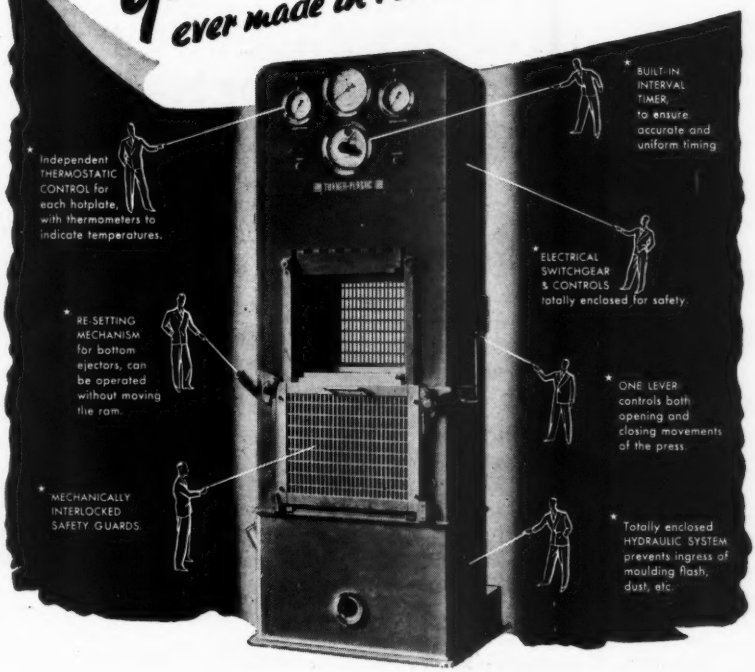
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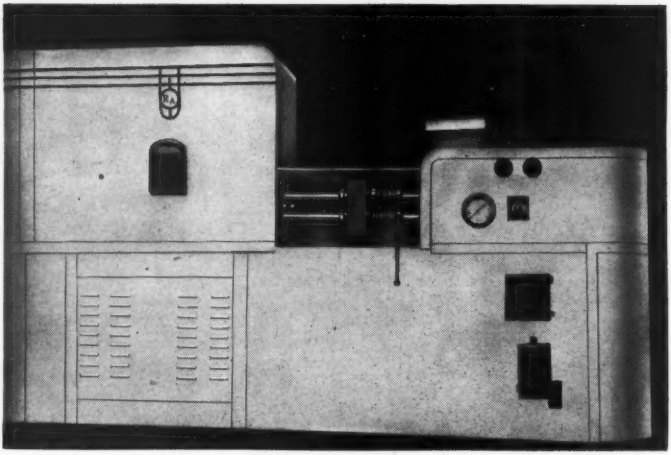

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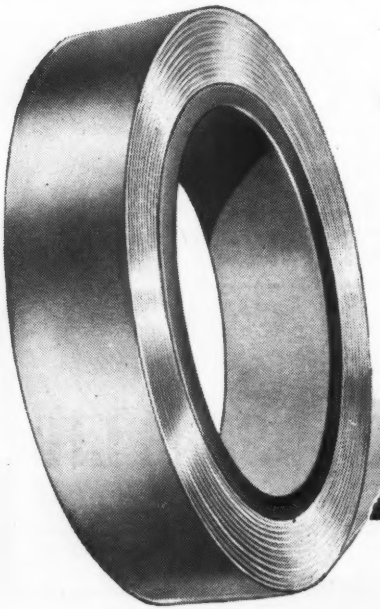

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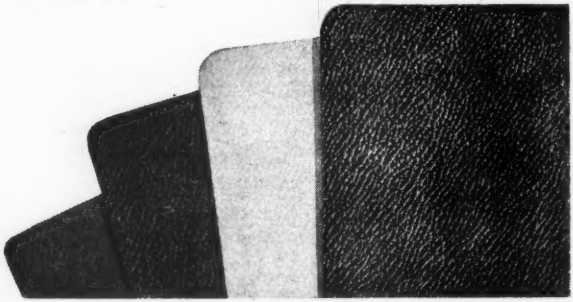

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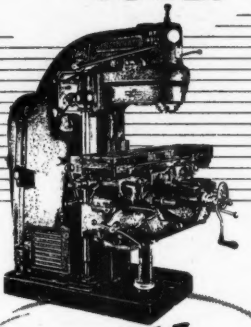

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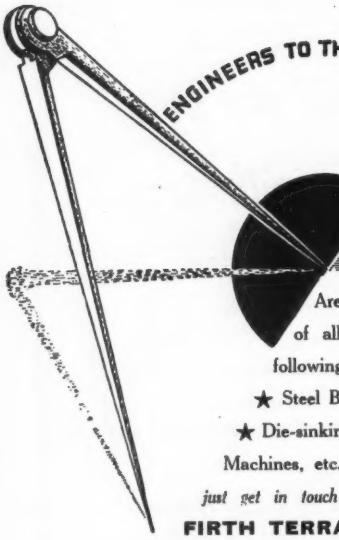

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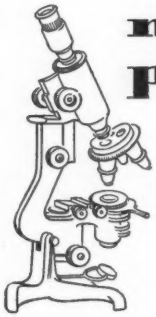

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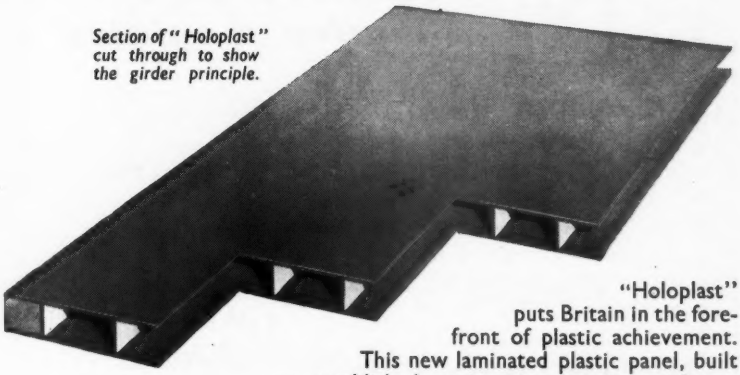

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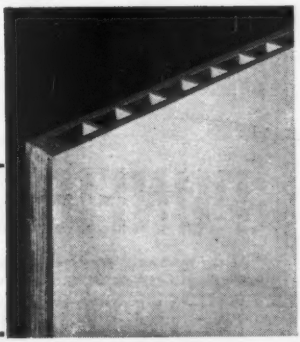

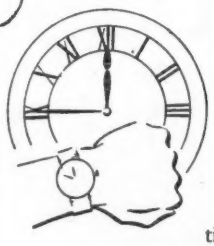

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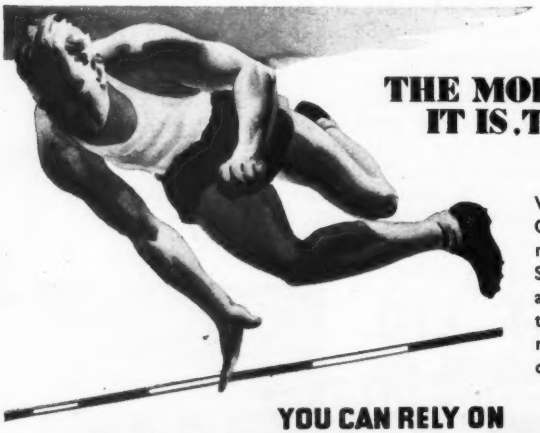

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Vol. XI. No. 120. MAY, 1947

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - TEMPLE PRESS LIMITED
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NOTICES

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EDITORIALS

The Federation Lunch

LOOKING around from our eminence at the Press Table last month, on the occasion of the 13th annual luncheon of the British Plastics Federation, at nearly 300 individuals gathered together in the largest banqueting hall of the Savoy Hotel, we considered the fact of the extraordinary increase in the membership of the Federation compared with pre-war days and how the stature of the industry was reflected in the attendance of so many important guests from the Federation of British Industries, the Board of Trade, the Ministry of Fuel and Power, the Home Office and from the great groups of "customers" in the electrical, automobile, aircraft, radio and other industries.

We also considered the words of Sir John Anderson in June, 1946, at a luncheon of the Institute of the Plastics Industry. He said that the industry was a small one and (we could scarcely believe our ears) that it would always be a small one.

That the industry is by tonnage comparison with many of the older industries quite small is a statement of fact, but to some in the industry who, like ourselves, only twenty-odd years ago could count the important concerns carrying out moulding on the fingers of two hands and who now see some 500 moulding factories extremely technically constituted for the most part, some 50 producers manufacturing raw materials for the aforesaid moulders, in addition to fabricators and laminators, yet another group of some of the greatest engineering works in the country providing the machines for doing the various jobs, the rise in the production curve of raw materials and finished goods in those 20 years, is a thing to marvel at, and to send pleasurable palpitations to any Chancellor of the Exchequer possessing foresight.

Certainly Mr. Charles Waghorne, the Chairman of the Federation, who has been as long as most in the industry, did not appear to be guiding the fortunes of an insignificant industry. Indeed, his speech of welcome to the guests who represented the greatest industrial powers in the country conveyed in no uncertain manner the growing stature of our industry.

Nor did Sir Frederick Bain, Chairman of the Federation of British Industries, in his reply, have delusions on this point, especially when he pointed out its increasing strength, the powers of organization that were displayed during the war years and the quality of collaboration that existed between the plastics industry and the Ministry of Supply through that admirable liaison officer, Mr. L. P. B. Merriam, the then Controller of Plastics. We suggest that the smooth-working relationship that existed then could have served as a model to many older industries.

What is an irrefutable fact is that the industry is small, and always will be comparatively small, from the point of view of intake of workers, but we have yet to believe that this is an exceptional economic disadvantage. The truth is that the industry is a highly technical one, in many branches highly scientific; that more machines are being used in it than in most others; that being based on both chemical and engineering sciences, the advances in improvement of existing raw material, in the production of new ones and in the development of new machines and new processes, far outstrip in speed those in any other endeavour in industrial history.

It is not necessary here to detail the long list of industries which are fed with the products of our industry and what changes have come over the industrial and economic face of the world as a result of them. This is not "an apology

for our existence." Still less is it a claim that plastics are a panacea for all ills. But we do insist, that, cleared of the dross that clings to all industrial and commercial endeavours, and so long as plastics are used functionally and for the special and peculiar characteristics they possess, there are in this industry of ours potentialities possessed by few that have gone before it.

Comparisons are often invidious, but as one little example to pursue our point we cite a report that has come to us as we write these words. Its importance lies in the fact that it is an engineering report, from one of the greatest metal-working concerns in the whole world, and that what is approved by the engineer-scientist sets a standard for most other branches of industry. It concerns "fitness for purpose" words which should, and will, we hope, be found engraved on the hearts of all workers in the plastics industry. Here it is. It shows where we are going and why.

Technical Interlude

THE report is entitled "Synthetic-resin Bearings," by F. W. Jones, B.Sc., M.I.Mech.E., A.M.Inst.C.E., a member of the engineering firm of Guest Keen Baldwins Iron and Steel Co., Ltd., and is published in the April, 1947 issue of the Journal of the Iron and Steel Institute. The paper must be read in its entirety for a complete understanding of the problem, but the following information is enlightening. The project began in 1936, when a new 21-in. mill was equipped with synthetic-resin bearings.

The cost of a set of bronze bearings in 1937 was £325, whereas the cost of the synthetic-resin type was £235. From the bronze bearings a bearing life of up to 11 months is expected, whereas the synthetic-resin bearings gave a bearing life up to 30 months. Up to 19 per cent. in power consumption was saved, and the whole cost of grease lubrication, about £70 per week (three-shift operation), is eliminated.

We knew in broad outline of the advantages of these resin bearings, but these figures, obtained as a result of some 10 years' examination, give some indication why we think our industry important and destined for big things.

Peace-time B.I.F.

EIGHT long years have passed since the last British Industries Fair, and now, once again, we are showing the world our manufactures at Olympia and Earls Court in London and at Castle Bromwich in Birmingham. The foreign buyers have gathered here from all quarters and are seeing with their own eyes that this country can still lay fair claim to be "the workshop of the world" for so many products in a quality unsurpassed by any other group of workers.

What changes in our own industry have occurred since 1939? In addition to vastly increased production of the well-entrenched raw materials, we now have nylon and polythene in large production, melamine and silicone resins in selected ranges; the growth to greater stature of polymethyl methacrylate, polystyrene and polyvinyl chloride, and the almost universal adoption of phenolic and urea adhesives for wood and metal adhesion; the creation of new forms, such as very high impact resin mixtures, expanded plastics, sheets of hollow construction which, based on sound engineering principles, provide tremendous strength, and the very latest soft asbestos-resin felt which has not yet been described in the literature; the development of new processes such as the preheating by "radio frequency" of powders to produce better mouldings more rapidly, the welding of thermoplastics and postforming of laminates; the growth at last of a strong nucleus for the production of all machines necessary to the industry; and finally, a spate of ideas and new designs for finished goods that is unsurpassed.

This much we offer two short years after the close of the war. It is there for the world to see and to buy.

Radio Cabinets

RARE and seasoned woods being what they are—things that only old men remember—cabinet-making for the radio industry is in a dilemma, and many designers have turned once again to plastics.

There is little doubt that wood is an ideal material for the purpose, considering all things, but there is also no doubt that plastics can cut its own special swathe in this vast industry, and also its younger relation, that of television. Whether this is a most suitable time, however, for greater demands to be made on our industry, is open to question. Supplies of plastics will be no greater this year. In spite of this the fact remains that the situation offers an admirable opportunity for new raw materials, especially since there have been so many advances, new types and new methods during the past 10 years. Moreover, several concerns, veering slightly from the "all-plastic" conception, are very anxious to try out their ideas of using plastics-wood-metal combinations.

The moulded phenolic resin type has always retained a fair market. The lighter-coloured urea resins were soon afterwards accepted and to-day some of the most beautiful cabinets are of this type. At the B.I.F. will be seen some exceptional samples of combinations, the front half being of cream-coloured "urea" and the back half of black phenolic—a very pleasing combination.

The cast phenolic resin type with its beautiful colour possibilities has always been a favourite material for very small cabinets in the U.S.A., but has rarely been adopted here.

The radio industry know these well and in order to spread their net wider are examining other materials not hitherto used in this country.

Thus "Perspex" comes on the scene and to-day several prototypes are being made from the opaque material in sheet form. Obviously the idea is not new and it will be interesting to see how the public react to them. Another obvious possibility is that of cellulose acetate, although we have not yet seen an example. The photograph we publish on page 229, however, of a clock in this material which is being shown at the B.I.F., exemplifies the possibilities.

Laminates have never, so far as we know, appeared in the picture; a great pity, for their strength and design possibilities are very great, and construction from them is simple once the methods are understood. There is, however, one process concerning them which should prove promising now—we refer to the post-forming process. Many visitors to the recent "Daily Graphic" exhibition in Lower Regent Street, London, admired the suitcases made by this process. They are tremendously strong and have a colour and texture that we are sure would prove very acceptable.

Floating Exhibition

The M.V. "St. Merriell," of the Saint Line, is on its way to the Latin Americas with its biggest hold fitted up as an exhibition. Among the exhibitors are Erinoid, Ltd., with an unusually comprehensive display of casein, cellulose acetate, p.v.c. and other raw materials and finished goods, and the prototype of the Reed-Anderson injection machine built by Reed Bros. (Engineering), Ltd. The machine will be working full out turning out lovely cameo brooches from Erinoid acetate, for the ladies of Buenos Aires, Montevideo, Rio de Janeiro and other ports of call. Good hunting!

Monsanto Chemicals

The news of the appalling disaster at the Texas City factory of Monsanto Chemical Company has filled this country with horror. We extend to our American friends the heartfelt sympathy of ourselves and the British plastics industry.

Erratum

We must apologize for an unfortunate slip last month that crept into Mr. Stannett's tribute to Dr. Wallace Hume Carothers. During the type-setting the name in the author's script was altered to Dr. William Hume Carothers.

First Peace-time
BRITISH INDUSTRIES FAIR

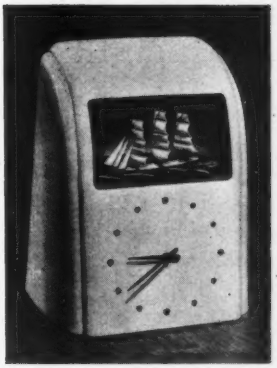


Fig. 1.—Novelty clock, with moving ship and lighting effects, utilizing cellulose acetate products of British Celanese, Ltd.

THE British Industries Fair opened in London and Birmingham on May 5 for a duration of 11 days. It closes on Friday, May 16. For eight years there has been no Fair, due to the circumstances of war, but those intervening years have seen many important developments taking place in industry—the plastics industry included in no mean degree—and the revival of the Fair provides a notable opportunity to examine these developments in peace-time uses.

In the Plastics Section, at Earls Court, London, there are about 80 exhibitors, or, roughly four times the number represented in 1939. Developments resulting from intensive research, aided by war-time experience, are reflected in new raw materials and finished products alike. The range of materials for the plastics industry has increased considerably. At the present Fair, synthetic resins are being shown by 21 different firms; laminated materials by 20, and mouldings of one sort or other by 60.

Unfortunately, our date of publication for this issue of "Plastics" has fallen awkwardly with respect to the opening and closing of the Fair, but we give below a report of many of the exhibits in the Plastics Section, together with illustrations of some of the features which caught the eye.

A comprehensive range of clock cases, bathroom fittings and other goods, which have been designed to combine with the best possible effect decorative laminated panel material and phenolic-resin mouldings, is shown by Andover Plastics, Ltd.

Bakelite, Ltd., have a display which treats in broad terms the uses of Bakelite materials in housing, electrical and engineering industry, and transport, which applications are now absorbing nearly the whole of the company's output. One interesting feature of the stand is a large original design symbolizing the origins and uses of Bakelite plastics; this is incorporated in a 6-ft. by 3-ft. "Warerite" panel.

Unbreakable polythene beakers (Fig. 11) were seen among the products exhibited by Barclay-Stuart (Plastics), Ltd.

British Celanese, Ltd., show the range of cellulose-acetate plastics. "Celastoid" sheets are displayed in a range of pastel colours, opaque, clear, pearl finish and embossed grades. End uses include optical frames, watch and clock bezels, lampshades, sequins, compacts, fancy jewellery, protective eyewear, toys and transparent containers. "Celastoid" extruded sections include simple and complex contours, which can be made up to 10 ft. or longer.

British Industrial Plastics, Ltd., endeavour to show the versatility of the products made by their associated companies. A new group of Beetleware mouldings by Streetly Manufacturing Co., Ltd. (Fig. 3), includes a salt and pepper shaker, a mustard pot and a sugar dispenser, which are a great improvement in design on the pre-war versions of these articles. Beetle Products Co., Ltd., show melamine moulding materials and the decorative and industrial mouldings made therefrom by a number of customers. B.I.P. Tools, Ltd., have steel moulds and dies, and samples of the articles moulded by their use. Beetle Bond, Ltd., show applications of "Beetle" cement, including Beetle-bonded plywood and wooden laminates.

Among the exhibits by British Moulded Plastics, Ltd., we observed two sample mouldings which make up the new moulded cabinet for Ferguson radio (Fig. 2). The black body portion is moulded from phenol-

Fig. 2.—Black p.f. and white u.f. mouldings of new radio cabinet by British Moulded Plastics Ltd. for Ferguson Radio Corporation, Ltd.

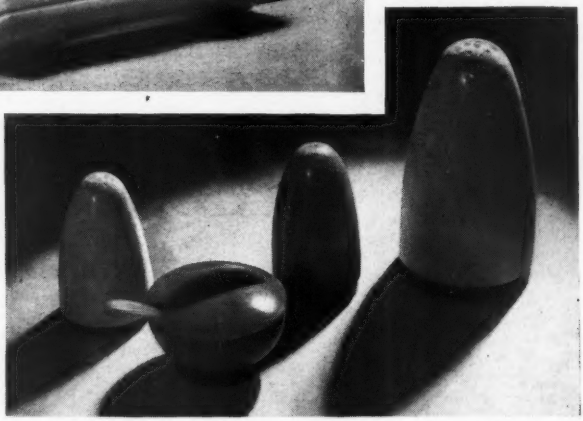


Fig. 3.—A new group of "Beetleware" mouldings for salt, pepper, mustard and sugar, by Streetly Manufacturing Co., Ltd.

formaldehyde moulding powder and the cream front portion from urea formaldehyde. The cabinet was designed by Ferguson Radio Corporation, Ltd., but the mechanical idea which provides a totally enclosed plastic housing for the set was the work of the Design Department of British Moulded Plastics, Ltd. The two parts are secured at the bottom to the chassis of the set, and at the top two metal pins pass through the back moulding into threaded inserts in the face moulding. Particular attention has been paid to proper ventilation by the provision of louvres.

British Mouldex Rubber Co., Ltd., include a display of the new "Rylon" vinyl upholstery material, which is claimed to possess remarkable ability to withstand flexing, cracking and abrasion; also "Mouldex" flooring tiles.

Leather cloth (Fig. 4), produced from "Chlorovene" paste, is featured by British Resin Products, Ltd. Our illustration also shows an easy chair covered in Bernard Wardle's "Everflex" by Advance Enterprises, Ltd. Emphasis is laid on a wide variety of uses of "Chlorovene" paste, which has opened a new field in the plastics industry.

Among a wide range of products, BX Plastics, Ltd., have a display of "Styrafoil" orientated toughened foil; also "Styrathread" extended tensilized threads or filaments of polystyrene, which is now available as a result of this company's research and development. A number of applications are anticipated for this material in the electrical industry, particularly in the high-frequency cable field, where a combination of "Styrathread" wound spacers and "Styrafoil" tape insulation may introduce entirely new designs for high-frequency

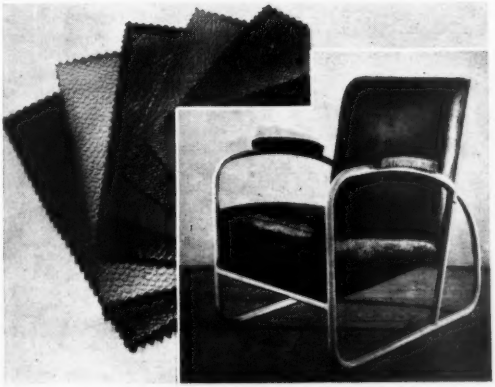


Fig. 4. — Leathercloths produced from Chlorovene paste (British Resin Products Ltd.); the chair covered with same, by Advance Enterprises Ltd.

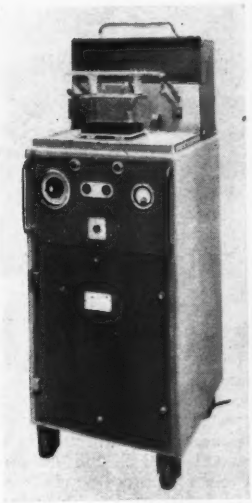


Fig. 6.—Radio frequency dielectric pre-heater for the plastics industry. (E.M.I. Factories Ltd.)

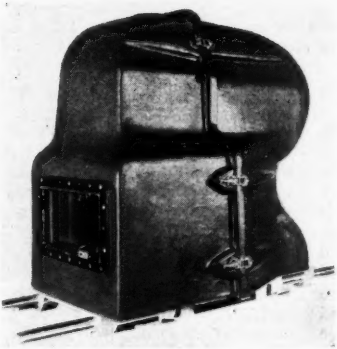


Fig. 5. — Soundproof cover for ciné camera in laminated cellulose fibre, as used for prototypes without expense of complicated moulds. (Pytram Ltd.)

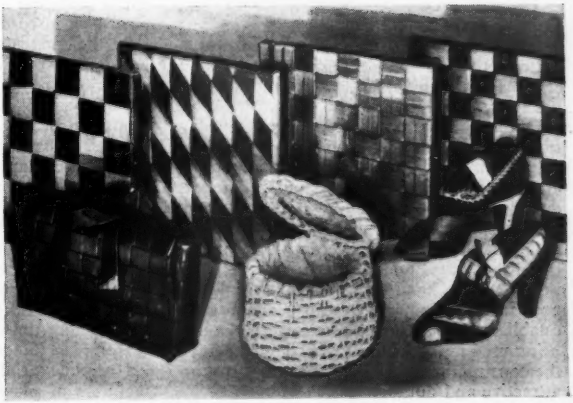


Fig. 7. — Chair seats and other goods made from "Durastrip" extruded p.v.c. (Duratube and Wire Ltd.)

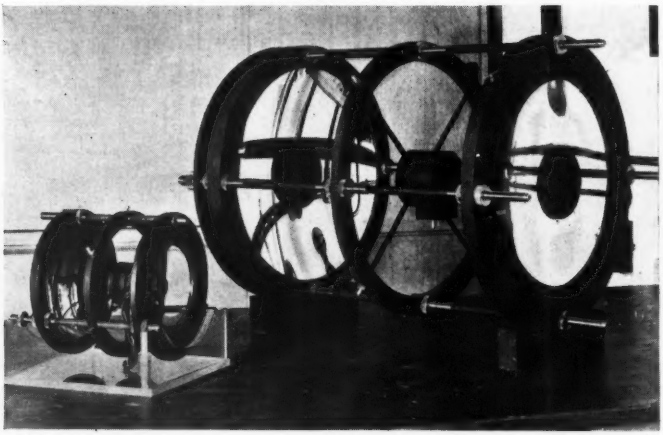


Fig. 8.—Television projection systems (Schmidt) with aspherical lenses and mirrors of "Transpex" by Plastics Division of I.C.I. Ltd.

co-axial and symmetrical high-frequency cables.

Modern decorative laminated plastic material for walls, panels, doors and all interior decorative uses, in attractive colours, wood grains and finishes, including a "cigarette-proof grade" of "Formica," is featured by De La Rue Insulation, Ltd. "Delaron" synthetic-resin-bonded laminated board with either paper or fabric base, and "Traffolyte" laminated material are also shown, as well as all types of p.v.c. and cellulose acetate-butyrate extrusions (the latter being products of the associated company, De La Rue Extrusions, Ltd.).

The stand occupied by Dufay-Chromex, Ltd., covers the whole range of products which this company manufactures in plastic materials. The outstanding exhibit is a chair (Fig. 10) manufactured from "Dufaylite" low-density interlayer.

Duratube and Wire, Ltd., have a display of the most recent fashions and novelties (Fig. 7) made from "Durastrip," which is an extruded p.v.c. produced in 35 different designs and sizes, ranging in width from ¼ in. to 3 ins. This material can be supplied in more than 20 colours, including translucent, metallic shades, and multi-colour combinations. Belts, hand-bags, shoes and flower posies made from "Durstrip" are already established favourites. This material is also being used in the leather goods industries for the construction of chairs, where it forms an attractive and durable finish.

Radio frequency dielectric pre-heaters are exhibited by E.M.I. Factories, Ltd. The heater illustrated (Fig. 6) gives an output of approximately 1 kW. of high-frequency power at the electrodes, which will heat about 0.75 lb. of general-purpose moulding powder to 120 degrees C. per minute.

Cellulose-acetate moulding powders are the main feature of the exhibit by Erinoid, Ltd. In addition, there is a very complete range of goods in various stages of manufacture, ranging from plastic jewellery to motorcar steering wheels. Mouldings of toys and dolls' furniture represent a welcome change from the more austere things for which cellulose-acetate moulding materials have been used during the past seven years. For the first time, polystyrene moulding powders make their appearance.

The theme of the stand occupied by Holoplast, Ltd., is to illustrate "Holoplast" as a constructional material in modern applications. The wing of a typical industrial building, comprising laboratory and office with separating corridor, has all doors, partitions, built-in cupboards, shelves, ceiling and floor of "Holoplast." Sound-insulating properties are demonstrated by a double partition with the cavities filled by foamed slag; sound-absorption qualities, by perforated acoustic panels fitted in the ceiling. In the office the whole of the furniture is of "Holoplast" construction.

Hornflowa, Ltd., who are primarily manufacturers of plastic buttons from their own

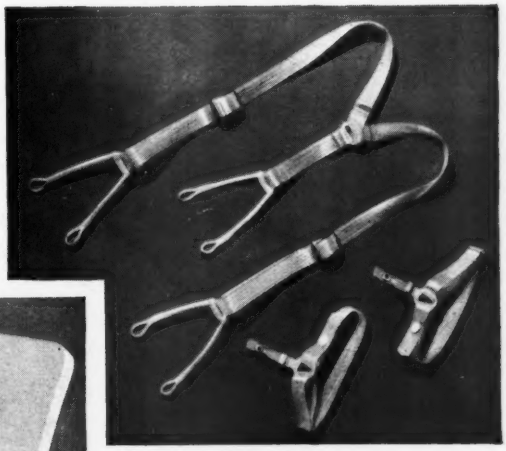


Fig. 9.—Braces and suspenders, entirely of thermoplastic extrusions (Tenaplas Ltd.), by Kenrick's, of Nottingham.

Fig. 10.—Chair, with "Dufaylite" as interlayer and $\frac{1}{16}$ in. plywood skins, covered with fabric (Dufay-Chromex Ltd.).

raw material, a urea-formaldehyde hornmeal compounded by compression moulding, are, for the first time, showing buttons with mottling obtained by a new process, to which we hope to make further reference in a future issue of "Plastics." By use of this process it is possible to closely imitate the natural marking of horn, and also to give very close degrees of colour matching in buttons for use upon Harris tweeds.

The central feature of the Plastic Division stand of I.C.I., Ltd., is the television projection system making use of aspherical lenses and mirrors from "Transpex" 1 and 2 (Fig. 8). This system, which was originally designed for astronomical cameras by Schmidt, consists of a large aperture concave mirror which projects forward light from a cathode-ray tube. An aspheric corrector plate is employed to correct spherical aberration. The system takes a 3¼-in. projection cathode-ray tube and gives a magnification

Fig. 11.—Unbreakable beaker of polythene, by Barclay-Stuart (Plastics) Ltd.

of 7½ times. It has a focal ratio of f/0.8 and provides clear, bright pictures from relatively weak cathode-ray tube pictures. This optical system, made by a newly developed I.C.I. process known as "surface finishing," operates with great accuracy.

Injection Moulders, Ltd., make a feature of their new plastic coat-hangers (Fig. 13), overall length 17 ins., moulded in cellulose acetate of various colours. In design, this coat-hanger is good from an engineering standpoint, and it is sufficiently tough and resilient to perform satisfactory service.

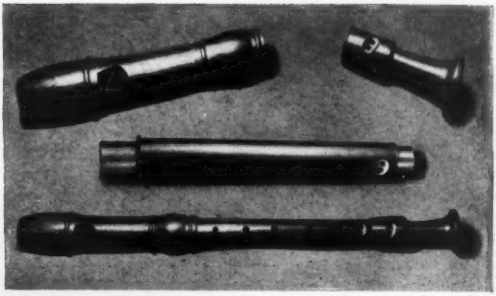


Fig. 12.—Dolmetsch treble recorder, a phenolic moulding by Insulators, Ltd., accurately based on the wooden hand-made instrument.

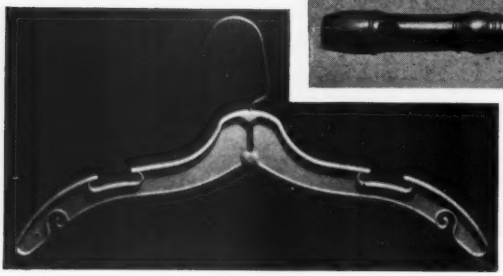


Fig. 13.—A new design in coat-hangers, injection moulded in cellulose acetate (Injection Moulders, Ltd.).

A Dolmetsch plastic treble recorder (Fig. 12), to the design of Arnold Dolmetsch, Ltd., is one of the mouldings shown by Insulators, Ltd. Hitherto, high-precision recorders have been hand-made in wood. Such standards of perfection, however, were rather costly, and the need of a really sound instrument at relatively low price has long been apparent. This has been met by the present exhibit, which is a moulding of highest quality with internal dimensions, voicing and finger-hole diameters accurately based on the hand-made instrument. The instrument has a range of nearly 2½ octaves, perfectly in tune.

Leicester, Lovell and Co., Ltd., make a special feature of "Cascophen" resorcinol formaldehyde resin for room temperature and hot-press gluing. To demonstrate the high degree of reactivity which characterizes resorcinol resins, as also gap-filling and boil-proof properties, they have a small plywood keg constructed throughout with Cascophen R.S. 216, in which water has been kept boiling for several weeks without leakage occurring.

Materials in the piece, and a few new novelties in manufactured articles, based on p.v.c. are exhibited by B. Lipman (Plastics), Ltd. Included are plastic-coated fabrics, and grained and embossed p.v.c. sheeting as leather alternatives for upholstery, handbags, fancy goods, etc. Plastic-coated papers for packaging purposes and water dyes for colouring methyl methacrylate, cellulose acetate, ethyl cellulose and vinyl plastics are also shown.

Surfacing, under the name of "Melloroid," produced from plastic processed on fabric, a development of Mellowhide Products, Ltd., possesses the essential flexibility and tensile strength necessary for upholstery and the fancy goods trade.

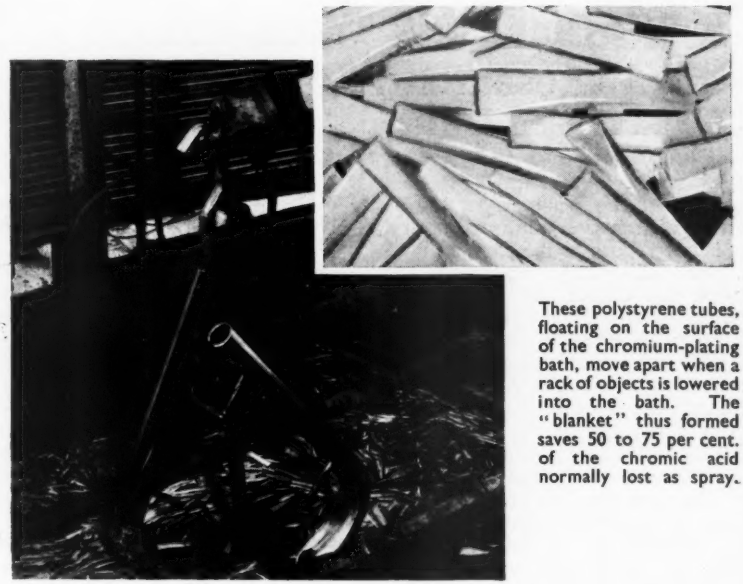
Articles of furniture, including office desks and television cabinets, made from "Selenore" wood-fibre composition board with resin-bonded flush joints, provide for the exhibit by Metropolitan Plywood Co.

A lightweight, soundproof cover, technically known as a "blimp" (Fig. 25), for a technicolor ciné camera, shown by Pytram, Ltd., totally encloses a standard ciné camera and is used outside the studios "on location." Pytram material proved ideal for this purpose owing to its great lightness and powers of sound insulation. The cover is of considerable size and of a complex nature, due to the need for it to follow roughly the outline of the camera, yet it can easily be handled by one man.

Lavatory basins made of "Perspex," and plastic safety beacons provided with a clear panel which permits a beam of amber-coloured light to be thrown upon the crossing at night, are featured by Splintex Safety Glass, Ltd.

Travel bags in plastic or with plastic trimmings, and plastic millinery, are shown by Sportapools, Ltd.

(Continued on page 262.)



These polystyrene tubes, floating on the surface of the chromium-plating bath, move apart when a rack of objects is lowered into the bath. The "blanket" thus formed saves 50 to 75 per cent. of the chromic acid normally lost as spray.

Remedy for a Plating-bath Trouble

COSTLY were the problems which the chromium-plating industry faced before the war; there was considerable loss of chromic acid from the bath in form of fine spray; loss of heat from the bath; complaints from occupiers of adjacent property concerning fumes.

When The Udylite Corporation, of Detroit, Michigan, who are suppliers of electro-plating equipment, approached The Dow Chemical Co. for guidance in working out a remedy, Chrome-Lock tubes made of extruded "Styron" (Dow polystyrene) were evolved. These tubes, 2¾ ins. long, closed at each end to resemble miniature pillows, are merely floated on the bath in sufficient depth to form a "blanket" for preventing the escape of the fine spray.

The simplicity of the device is clear from the accompanying illustrations. The tubes are simply dumped into the chrome plating bath in sufficient number to form the desired blanket; the thicker it is the less is the loss of chromic acid. Tests have proved that without the tubes 33 mg. of chromic acid may be present in each cubic metre of air collected a few inches above the surface of the bath. With a one-inch blanket, only 1.2 mg. were present per cubic metre of air, and with a two-inch blanket losses were cut still further to 0.8 mg. In all cases the blower system was shut down and the current was between 440 and 460 amp.

Whilst a blanket of these polystyrene tubes saves from 50 to 75 per cent. of the chromic acid ordinarily lost, the protection they give plating room employees against the hazards of chromium plating is notable. Additional compensations to the user include a need for less heat to keep the bath at the correct operating temperature, and a saving of power by cutting down the quantity of air normally withdrawn by the fan.

Plastics Industry, Trade and Research in the Netherlands

By G. B. E. Schueler*

THE whole of Dutch industry during the five years of war—"working on the principle of resistance"—suffered from lack of raw materials as well as shortage of technical information. In a new industry, such as the plastics industry, such information was vital and research was carried out on a limited scale under difficult circumstances, but only vague information was available of new German developments, and, of course, contact with the American and British plastics industries was impossible.

With a large part of Rotterdam destroyed by the enemy, with a considerable section of The Hague flattened by the Allies, and with loss of a large proportion of the industrial population, the three industrial cities in the Netherlands faced some considerable problems. Yet it is obvious to the visitor of to-day that a quick recovery has been made. The Government has dealt efficiently with the food situation, while the fuel position is improving considerably from day to day on account of the substantial output of the Government coal mines in Limburg. Finance is also being put in order, and the Dutch are looking forward to a balanced budget which will again establish their position as a sound customer for every exporter in the world. The discovery of oil in the Coevorden area gives them petrol off the ration and the hope of a new industry from its by-products.

Before World War No. 1 commencing in 1914, Holland was mainly a food producing and trading country; the main sources of wealth came from the Dutch East Indies and the shipping along the German rivers with an export and import trade throughout the world. When in those days they were cut off from their main sources of industrial products, they created (within a few years) new textile and machinery industries, which continued to flourish throughout following years in spite of competition from the large producing manufacturing countries.

Again, to-day, the Netherlands is facing a new period. Its people will have to regain prosperity without being able to rely on a prosperous trade with Germany and the East Indies. Unlike other small countries, such as Switzerland, Denmark or Sweden, which were able to return to their pre-war occupations, the creation of new industry in the Netherlands has a much wider and deeper meaning. Moreover, the Dutch, with their very high level of education (four languages being taught in school) and their native adaptability to all kinds of situations, will be quick in using every available opportunity.

The plastics industry offers them such an opportunity, and the author of this article during his recent visit was most impressed to witness the keen interest and thirst for knowledge among Dutch technicians and officials for any war-time developments in plastics in Great Britain.

It is not expected that in 1947 the very rigid import "prohibitions of luxuries," such as plastics, will be relaxed. Licences have been granted and are likely to be granted in greater volume for raw materials, moulding powders and machinery, but the import of finished products will be limited to utmost necessities.

The Government, as well as business circles, have apparently decided on a most progressive policy to put the plastics industry on its feet, but they are restricted by the shortage of foreign exchange. Nevertheless, substantial orders have been placed for phenol, wood flour, formaldehyde, cellulose acetate, phthalic

* The author has just returned from a visit to the Netherlands, where he interviewed leading members of the Government and business circles.

anhydride, etc., but owing to world shortage deliveries are slow. Substantial orders for injection moulding machines, extrusion and chemical machinery have been placed abroad, as none of these items are at present being manufactured in the Netherlands.

The shortage of moulding powders has forced the Control to limit its use for electrical mouldings, mouldings for the building trades (door handles, etc.), and the food industry (e.g., bottle closures).

The artificial horn industry had a long period of stagnation after the war owing to the lack of casein, but these difficulties have now been overcome. Capacity of production, however, is not yet on a pre-war scale on account of damage during the period of enemy occupation, but it is expected to rise again very shortly, as this is a raw material that can be found in the Netherlands. Research in plastics derived from starches is being carried out on a considerable scale, but whether or not these materials will be a commercial proposition has yet to be seen.

The paint industry is included in the plans, but here again the shortage of essential raw materials creates difficult problems, which also applies to plastics adhesives for the wood and furniture industries.

With regard to the manufacture of p.v.c. and other vinyl derivaties, detailed plans have been put in hand, but the most likely start is going to be with manipulation only, such as extrusion. Injection moulding of various imported materials should commence as soon as the numerous machines that have been ordered are delivered. Methyl methacrylate is being imported from England, and it is expected that the Netherlands craftsmen will find good use for this material.

Low-pressure moulding would seem to have good prospects in the Netherlands, as the machinery needed is comparatively simple, and the wage status of the Netherlands would be favourable for this process.

However, everything tends to show that the shortage of foreign exchange (which prevents the import of finished plastic products) and the shortage of raw materials in the world (that limits the import of moulding powders) will make it likely that the Dutch consumer waits some time before he will see plastics in the shops.

Organizations in the Netherlands that are concerned with plastics fall into three groups:—

(a) Government control.

(b) Research organizations.

(c) Trade associations.

Under Group (a) we have, among others, the Ministerie Van Economische Zaken "Rijksbureau voor Chemische Producten," Benoordenhoutscheweg 46, The Hague. This bureau is similar to our war-time Plastics Board of Control. It will sanction the licences for the import of raw materials, such as chemicals and moulding powders necessary for the manufacture of plastics.

The Ministry of Economic Affairs has organized certain sub-committees; for instance, a committee to study the development of plastics in America, having among its members Dr. J. C. Derksen (of Philips, at Eindhoven), Mr. H. A. Frank (of Rijksbureau voor Chemische Producten, The Hague), and Dr. Ir. R. Houwink (director, Rubber Stichting, Delft). This committee has already returned to the Netherlands and reported in detail. Another committee, composed of leading persons in the Government and in industry, is investigating the possibilities of such developments in the Netherlands; it is under the chairmanship of Dr. G. A. Kohnstamm (chief, Department of Technical-Economic Problems of the Ministry of Economic Affairs).

Under Group (b), one of the research organizations which deserves particular attention is Applied Scientific Research (T.N.O.), an organization for co-ordinated research in which the Government participates, and which has, among others, the following departments:—

(a) Rubber Institute T.N.O. (research in natural rubber and its substitutes).

(b) Plastics Institute T.N.O. (research in plastics).

(c) Central Institute for Material Research (C.I.M.O.), director, Dr. C. A. Lobry de Bruyn, with sub-divisions for paint under Dr. F. J. Hermann, metals, timber and building materials.

Research by private organizations in the plastics or allied fields is carried on at the laboratory of the Government Coal Mines in Limburg (Staatsmijnen), the Philips factories at Eindhoven, the laboratories of Royal Dutch Shell (B.P.N.), the Research Institute of Art Silk Industries (Algemene Kunstzijde Unie), and the Rubber Foundation (director, Dr. Ir. R. Houwink).

Under Group (c), the trade associations which could be of interest to exporters of plastics machinery and moulding powders are:—

(a) Netherlands Association of Plastic Manufacturers (Nederlandsche Vereeniging Van Fabrikanten van Kunstharsproducten. This association includes a number of moulding firms mainly in the electrical field, but also producing optical frames, buttons, etc.

(b) Netherlands Chemical Association (Ned. Chemische Vereeniging), with sections dealing with colloid chemistry and micro-molecular materials.

(c) Organization for Knowledge of Materials (Bond voor Materialenkennis), which concerns itself with the mechanical properties of materials, including paint, rubber, asphalt and plastics. The plastics department is under the able management of Dr. P. G. Meerman.

From the existence of so many organizations it is obvious that there is live interest in the Netherlands in the search for technical knowledge.

Manufacturers who are interested in promoting trade with the Netherlands are recommended to send their catalogues to the Semi-Official Research Organization under the direction of Ir. I. C. Stoutjesdijk, the chief of the Information Department being Mr. H. A. Frank (Kunststoffeninstituut T.N.O., Julianalaan 134, Delft, Holland). Technical journals, or literature of British war-time plastics developments, would also be appreciated for enlightening Dutch manufacturers.

The author visited an interesting exhibition of foreign plastic materials at The Hague, but regrettably the display consisted in the main of products of purely American origin and literature. It will obviously be in the interests of British industry to provide the Netherlands at the earliest moment with the maximum amount of technical information. A lively mutual trade between Rotterdam, Switzerland and Sweden has already been developed, and Britain may expect a share of the market as soon as sufficient sterling balance has been accumulated.

Furnishing the "Mauretania"

Interior decorations of R.M.S. "Mauretania," which is now being refitted at Liverpool for the transatlantic passenger service after war-time use as a trooper, will include panellings and fitments of coloured "Perspex." It is the first time that "Perspex" has been used for this type of decorative work.

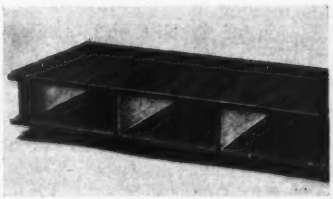
An attractive colour scheme in cream and green has been designed for the cabin-class hairdressing saloons. They will be panelled with sheets of cream-coloured "Perspex," supplied by the Triplex Safety Glass Co., Ltd., narrow green strips magnified under clear glass beading being used to conceal the horizontal joins, and the vertical edges of the panels chamfered to form a decorative V-shaped join. The same material is being used throughout cabin-class staterooms as splash-backs to wash basins; these will also be cream-coloured, with polished vertical edges and curved corners.

Grip-bar type handles to cupboards and wardrobes will have a coloured "Perspex" foundation with clear rounded glass superimposed. Push buttons for operating the locks will be incorporated in the handles.

Another innovation will be the extensive use of coloured "Triplex Laminated" safety glass with contrasting colour interlays for many of the ship's tables. The interlayer, which takes the form of narrow rectangular bands of contrasting colours is carried out before the glass is laminated and is thus completely sealed-in.

"Holoplast" for Ship's Cabin

In shipbuilding, "Holoplast" has hitherto found use mainly as interior bulkheading and for partitioning as in corridors. At the Shipwrights' Exhibition, held in London early this year, there was a successful demonstration of its use for the furnishing of ships' cabins throughout. The bunk, built-in cupboards and drawers, desk and other fitments, shown in the above illustrations, were all of "Holoplast" with figured Sapeli finish, and the general effect was most attractive.



Students' Plastics Discussion Group

DURING the session 1945-46, students of plastics technology at the Northern and Borough Polytechnics felt the need for some sort of discussion which would bridge the gap between normal lectures at the Polytechnics and the monthly meetings of the London Section of the Institute of the Plastics Industry. A committee was formed and throughout the summer various people were approached with a view to obtaining suitable speakers and ascertaining the reaction of technical schools, industry and the I.P.I. to the inception of such an organization.

Dr. Drakeley and Dr. West (Northern Polytechnic), Dr. Pickering and Mr. Maitland-Edwards (Borough Polytechnic) and Mr. Jukes (Southern Polytechnic), all agreed that such a society would be to the benefit of students and offered their wholehearted support and co-operation. Mr. Judd, secretary of the London Section of the I.P.I., also gave his approval. With this support the committee of the Students' Plastics Discussion Group prepared suitable leaflets, which were distributed to Polytechnic students on enrolment nights.

Membership of the Group is limited to past and present students of the plastics technology at the three Polytechnics already mentioned. Meetings are arranged by an organizing committee.

The first meeting of the Group was held at the Borough Polytechnic on October 11, 1946, when Dr. Pickering gave a short address of encouragement. He pointed out that the proposed Discussion Group might accomplish much, and would give students a chance to exercise their abilities as organizers, likewise encouraging impromptu speaking. At this meeting Mr. Farmsworth and Mr. Simpson, of Bakelite, Ltd., spoke on the preparation of commercial-type phenol resins and also the manufacture of phenol-type moulding powders.

The second meeting of the Group was held at the South-West Essex Technical School, on November 13, 1946, when four films loaned by the I.P.I. were shown. These films dealt with the moulding of intricate parts, general moulding technique, and the machining of laminated materials. They illustrated clearly the standard practice now utilized or desirable in the moulding shop. On December 11 a Brains Trust was held at the Northern Polytechnic, and Mr. Lever, of Vinyl Products, Ltd., taking the chair, the questions being answered by Messrs. D. Smith and D. S. Mahone (Bakelite, Ltd.), and Mr. L. W. Turner (Halex, Ltd.). On December 18 a small party visited the works of Fraser and Glass, Ltd., at the invitation of Mr. Walker, technical director.

On January 15, Mr. Walker, of Fraser and Glass, Ltd., assisted by Mr. Martin, opened a discussion on cellulose plastics. Many exhibits of British and American cellulose moulding were shown, and those students who attended fully agreed that they had obtained an insight into the technique of the moulding of cellulose plastics which would not have been possible during normal lectures. A visit to the Plastics Division of Imperial Chemical Industries, Ltd., at Welwyn Garden City was arranged for February 8, when Dr. Child and Mr. Keith gave much helpful advice.

On March 12 the Group held a meeting at the Northern Polytechnic, which was addressed by Mr. Evans, of Vinyl Products, Ltd.

This brief summary of the meeting already held by the Students' Plastics Discussion Group certainly shows that the Group has made an active start. If it continues to receive the fullest support of the students at the technical schools concerned, there is no reason why it should not play an important part in the technical training of students of plastics technology in the London area.

Further particulars regarding the activities of this Students' Discussion Group may be obtained from Mr. C. W. Welch, "Langdale," Woodside Grove, London, N.12 (Hillside 2510).

This toy train, with its gay clear colours, and wheels that really go round, is just one of the applications of "Perspex" in the children's post-war world. It is a prototype made by I.C.I. from a design by Bob Guttman of the Design Research Unit.

Credits: Beakers are test mouldings by I.C.I. in "Mouldrite" u.f.; dishes and plates in "Perspex" by Thermo-Plastics, Ltd., Dunstable; "Perspex" spoons and pushers by Haine and Priestley, Ltd., Gloucester; apron in polythene-coated fabric—an experimental material by I.C.I. Plastics Division.

Colour photographs by courtesy of I.C.I. Ltd.

World's Industry Employs Plastics

GENERAL ENGINEERING

Steel pipe giving resistance to corrosive conditions encountered in oil-well drilling is provided with plastic coating by Spang-Chalfant Division of National Supply Co., Pittsburgh (" Mechanical Engineering," 1947/**69**/152). Tests have shown that plastic coating prevents many pipe failures.

Machining and fabrication is discussed in " Mechanical World " (1947/**121**/257). Data relates to laminates, moulded components, solid non-reinforced materials, casein-formaldehyde, methyl methacrylate, polystyrenes, polyvinyl chloride, cast phenolics and cellulose plastics. Various operations are described. The use of sintered carbide and diamond tools is recommended in some instances.

Plastic protection, to be shrunk over ends of tubing, pipes, etc., during shipment or in storage, has been developed by General Electric Co., Pittsburgh. (" Machinery," N.Y., 1947/Feb./185.)

New " soft " hammer, claimed to have all the features of other types of soft hammers, but none of their disadvantages, is made from nylon by Danielson Mfg. Co. This hammer does not chip, has no rebound, is resistant to fire and oils, and does not heat up or change its shape under continued use. (" Machinery," N.Y., 1947/Feb./184.)

Thermoplastics mould release is estimated by new test which E. Ziegler, of Dow Chemical Co., revealed in paper presented before American Society of Mechanical Engineers (" Mechanical Engineering," 1947/**69**/160). After cleaning metallic specimen thoroughly, thermoplastic to be tested is compression moulded around the metal, and the force necessary to pull metal out of moulded plastic is measured.

Engineering developments of plastics are described in " Machinery Lloyd " (1946/Mar./68); the article deals with metal bonding, reinforced laminates, structural laminates, strut tests and applications of " Holoplast."

Resin-bonded diamond wheels for grinding carbides and carbide-tipped tools have been developed by Manhattan Rubber Division of Raybestos-Manhattan Inc. The resin-bond eliminates " loading " or glazing. (" Machinery," N.Y., 1947/Feb./218.)

AIRCRAFT

Honeycomb structure panel core produced by United States Plywood Corporation, and a class of vinyl plastics, under the trade name " Marvinol," have been developed by Glenn L. Martin Co. for the structure and furnishing of their aircraft. Applications of vinyls and acrylic resins in the equipment of the largest Douglas passenger air liners are given. (" Modern Plastics," 1946/**24**/90.)

Neoprene applications in product design are discussed in " Machinery," N.Y. (1947 / Feb. / 169). Neoprene-impregnated fabric diaphragms are used in one type of aircraft carburetter in the fuel-supply system in place of float mechanism; these diaphragms withstand continued exposure to benzene.

K

MOTORS

Full-vision top of ¼-in sheet Plexiglas is offered by Wright-Auston Co. It has no seams, is fastened to the car body in four points only, and, apart from colourless grade, can be obtained in red, green and blue tints. ("Scientific American," 1947/Mar./115.)

Tyres made from glass fabric have been produced experimentally by Pharis Tire and Rubber Co. For this use Owens-Corning have designed a special high-strength glass cord fabric. Two-ply glass fabric tyres are 40 per cent. stronger than four-ply rayon tyres. (Autom. and Aviation Industries, 1947/Feb. 15/76.)

Elastic impeder made of neoprene is used for rotary water pump in Flambeau outboard engine; it has 12 radial ribs, which are bent opposite the port openings. (Autom. and Aviation Industries, 1947/Feb. 15/39.)

CHEMICAL

Phenolic resins and synthetic rubbers can be blended in such varying ratios that all characteristics of both these material types can be utilized ("Materials and Methods," 1947/Feb./69). Addition of synthetic rubber gives increased compression set, increased tensile strength, rapidly decreasing elongation; tear strength, abrasion resistance and hardness increases.

Polytetra-fluor ethylene finds use as a material resistant to heat, solvents and corrosive agents, being also an electrical insulator. Low-pressure glass-cloth laminate is used as car body, made in two sections and weighing only 60 lb. Moulded nylon parts are introduced for coil bobbins, etc., owing to toughness over wide temperature range. Neoprene and silicones are also discussed. ("Machine Design," 1947/Feb./101.)

MISCELLANEOUS

New tooling plastic, Plasticarve, is described in "Tool Engineer" (1947/Feb./41). It can be hand-formed like clay, but possesses dimensional stability. In molten state it may be pigmented with almost any powdered colour, as used in paint making, and can be cast in wood, metal, plaster, latex, plastic or elastomer moulds.

Nylon extrusions in rods, ranging from ⅛ in. to 2 ins. diameter and from 2 ft. to 4 ft. length, are produced by new technique developed by the Polymer Corporation. Du Pont's nylon moulding powder FM-1 is used. ("Materials and Methods," 1947/Feb./145.)

Fiberglas plastics are discussed in "Materials and Methods" (1947/Feb./130); the reinforced material possesses a higher strength-weight ratio than common structural metals and will not corrode. Fiberglas laminates have good dielectric strength.

Rubber-resin compounds of thermo-setting type are discussed in "Modern Plastics" (1946/**24**/154). Experiments were made to find substances having the toughness of rubber, with the heat and chemical resistance, mouldability and rapidity in curing of phenolic resins.

Deep body cracks, which have been a large factor in the erratic behaviour of polystyrene components in service, have most outstanding of causes in thermally induced cooling strains which can be satisfactorily removed by an annealing process. ("Modern Plastics," 1946/**24**/127.)

Polishing of plastics may be achieved by application of glycerine, in much the same way as oxide coatings are removed from aluminium by use of glycerine. ("Wire and Wire Products," 1947/**22**/153.)

Rubber-frame goggle equipped with a large, single, acetate lens, specially designed to protect workers against chemical and dust hazards, is announced by American Optical Co., Southbridge, Mass. As special feature, the goggle can be worn with a respirator. ("Products Finishing," 1947/**11**/116.)

Creepage currents in insulating materials have practical aspects, according to J. F. Sterling ("Practical Engineering," 1947/**15**/70), where two different testing methods—"dry" and "wet"—are described.

Plastic hat, unimpaired by rain, and which does not shrink or lose its shape even when thoroughly watersoaked, has been announced by Adam Hat Stores Inc. after six years' research. The plastic body of the hat is said to be durable and to lend itself to modern styling. (Reuters Trade Service.)

Oil-well drill pipe often fails, due to internal corrosion pitting; thermosetting plastic prevents corrosion and retards corrosion fatigue failures. ("Scientific American," 1947/Mar./112.)

Rayon-laminated plastics, produced by American viscose Corporation, consists of a number of layers of resin-treated fabrics or fibrous mats laid together and pressed into a compact bonded plate or moulded article. Various applications are envisaged, such as gear-wheel stock, due to good tensile and high impact strengths. ("Scientific American," 1947/Mar./132.)

Dictating machine produced by Gray Manufacturing Co. uses permanent flexible plastic discs into which the sound groove is pressed. ("Machine Design," 1947/Feb./143.) A particular feature is the constant groove speed; 260 grooves are impressed on each inch of record diameter.

Metallographic specimens are suitably moulded in urea material, which fulfils requirements of low cost, ease of use and different colours for easy identification of metals. ("Scientific American," 1947/Mar./115.)

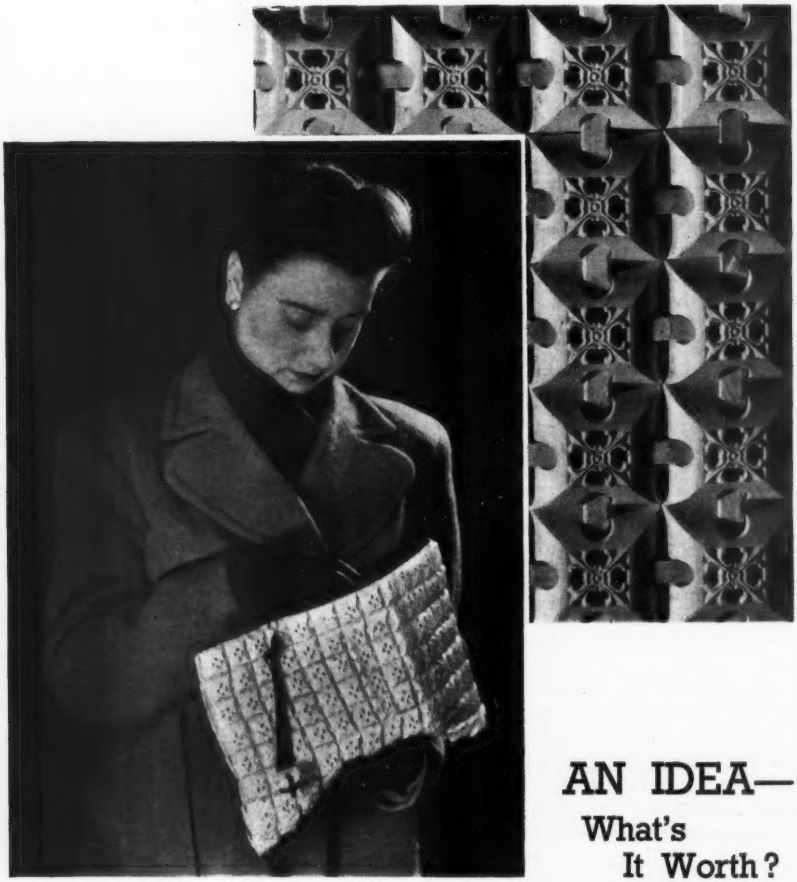
Synthetic waterproof adhesive (Faiprene No. 5,118 adhesive cement) is recommended for bonding Buna-N-type synthetic rubbers and vinyl films or stocks to rigid surfaces, such as steel, aluminium, glass, wood or cement. ("Machine Design," 1947/Mar./166.)

Plating racks provided with an odourless, non-inflammable plastic coating are offered by Peninsular Chemical Products Co. The coating consists of an aqueous dispersion of Saran plastic, and contains no organic solvents; it is applied by dipping and is said to be tough, flexible and highly resistant to all plating and metal-cleaning solutions. ("Automol Aviation Industries," 1947/Feb. 1/47.)

New wood-metal laminate, incorporating thermosetting resin adhesive, especially suitable for table-top construction in office desks, bank counters, etc., has been developed by Resinous Products and Chemical Co. ("Scientific American," 1947/Mar./137.)

SOURCES OF REFERENCE.

We wish to remind readers that the sources of reference from which these pages are compiled are not, in general, retained in this office. We cannot, therefore, undertake to supply such originals. Nevertheless, most of the foreign journals referred to are available in the Patent Office Library (Southampton Buildings, Chancery Lane, W.C.2) and in the Science Library (South Kensington). Photo-duplicated copies of articles may be obtained from the Photostat Dept. of the Patent Office.



AN IDEA— What's It Worth?

ONE of the most valuable and prolific of ideas of interest to the plastics industry was that which resulted in the comb, first put on the market roughly 100,000 years ago, the early samples being produced from pterodactyl teeth, brontosaurus bones, mammoth molars or elks' horns brought home to his bride by a handsome young cave-dweller. Since every female of the species from that time onwards would admit to have used anything from one to fifty during her lifetime, the comb industry can fairly claim to be one of the biggest ever, the numbers made being calculable only on the electronic "brain."

Many other jobs in the plastics industry can also lay claim to astronomical figures in production, but the latest example brought to me from the U.S.A. by Mr. Islyn Thomas, of the Thomas Engineering Co., of New Jersey, must provide a little record of its own.

The handbag shown in the photograph is highly commendable for its general smart appearance, but special praise is

due for the brilliant conception of its construction. The present example is some 14 ins. by 8 ins., built up of injection-moulded cellulose acetate units or "buttons," each 1 in. by 1 in. square, held and sewn on to the main backing fabric by an extruded strip of p.v.c. or lacquered tape threaded through each. In the bag shown there are 104 units in each side and four on the wrist-holding strap, making 212 in all.

The units and strips are all white here, but, obviously, colourful changes can be run in all sorts of fascinating ways. Mr. Thomas tells us that the idea was launched some few years ago in the U.S.A. by a Mr. Appel, and that Mr. Thomas's company made the early moulds and alone produced about 100,000,000 units. In all, some billion (one thousand million by American mathematics) were produced by all moulders and production still goes on.

Our agile-minded readers can calculate for themselves, roughly, how many bags have been made and how much money has been gathered in by the said Mr. Appel given that the bag shown is retailed in the U.S.A. at 6 dollars 50 cents.

These money-powder-key-lipstick-and-whatnot holders are now imported or made here, for I have just seen an exactly similar set on sale in Bond Street at 42s. per bag. (Mr. Graeme Ritchie, of Injection Moulders, Ltd., The Hyde, London, N.W.9, informs us that his company are now injecting similar "buttons." Presumably the Bond Street bags are fabricated from them.)

The financial story by no means ends here, for I understand that the ladies of Paris, Rome, Moscow, Przemysl, and Shanghai have not yet seen samples.

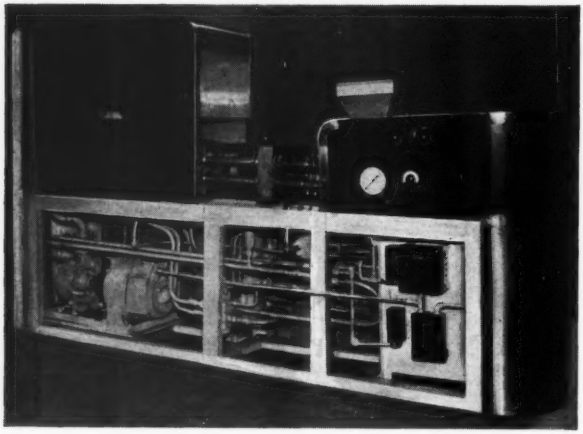
[NOTE.—I do hope that somebody very much in the know will not tell me that this idea is not new, but was first conceived by Mr. Banana, of Madrid. I have been caught out before, and it is most disconcerting. The important thing is, it is a jolly good idea, bravely launched; more power to Mr. Appel's elbow.]

DOGSBODDY.

This modern kitchen, with dining recess, at the recent "Daily Mail" Ideal Home Exhibition, was constructed throughout in laminated plastics produced by De La Rue Insulation Ltd. Walls and cupboards are faced with "Traffolyte" and "Formica" veneers of satin-finished light green colour, with a contrasting red for added decoration. The sink top, post-formed from "Formica," is black. "Formica" is available in a cigarette-proof grade, which has been used for all horizontal surfaces likely to suffer damage of this nature.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes



The hydraulic unit is the famous Andrew Fraser self-contained two-stage oil-hydraulic high-speed pump driven by a 3 h.p. motor (current to suit customer) in conjunction with modern pre-filling control and adjustable relief valves. Single-lever manual control to all operations. Pump mounted in machine base. Fully automatic action optional.

Combination of pre-filling valve with two-stage pump gives quick closing action, permitting full stroke for closing and locking in three seconds. Injection time for full stroke—3 seconds. Full movement cycle in 10-12 seconds, permitting up to 240 operations per hour, depending on size of moulding. (4 oz. single mouldings 60-70 operations per hour; 2-3 oz. single mouldings up to 180 operations per hour.)

The injection cylinder is electrically heated, thermostatically controlled; the main band heater by a thermostat constructed by British Thermostat Co., the back band heater by a Sun Vic control. The control of the nozzle is also carried out by a Sun Vic apparatus.

NEW INJECTION MOULDING MACHINE.— It has given us considerable pleasure to see the building up of the prototype of this machine, which, as we indicate on page 228, is installed on the M.V. "St. Merriel," the "exhibition" ship now on its way to the Latin Americas. Made to the design of Mr. D. Anderson, of Anderson and Powell, who has followed the engineering problems of the plastics industry for over twenty years, it is built and marketed by Reed Brothers (Engineering), Ltd., Millwall, London, E.14.

We may therefore rest assured that it is one of the most up to date of its type; for example, the designer, as a result of his experience, has avoided toggle construction.

The R. A. Injection Moulding Machine on show is a 4 oz. (113 grams) per shot one. Die plates diagonally tee-slotted, having an effective area of 11 ins. by 11 ins., provide ample space for multi-impression dies. Moulding area is approximately 30 sq. ins. Output is up to 35 lb. per hour, dependent upon size and shape of moulding. Distance between die plates 3 ins.-11 ins. Die-locking pressure is 90 tons by direct hydraulic power on 9-in. diameter ram with 9-in. stroke. Injection pressure is adjustable up to 10 tons per sq. in.

TRANSPARENT PACKAGING, to keep food fresh is to be produced in Great Britain. A factory is being erected at Wolverhampton by the Goodyear Tyre and Rubber Co. (Great Britain), Ltd., and will aim at a production sufficient for the wrapping needs of this country. Developed in the Goodyear laboratories, Pliofilm achieved considerable fame during the war, when its possibilities were very much exploited. Used extensively in America, it has become a familiar packaging for lettuce, fresh fruit and other perishable foodstuffs. Production at Wolverhampton is expected to commence by the end of this year.

GAUGE AND TOOL MAKERS' ASSOCIATION.—The quarterly luncheon will be held at the Savoy Hotel, London, on June 17, at 12.30 for 1 p.m. The guest of honour will be the Rt. Hon. Lewis W. Douglas, the recently appointed American Ambassador to Great Britain.

Members of the Association will leave London for Paris on May 16 to visit the International Fair at the Porte de Versailles. The Fair closes May 26.

Between 70 and 100 members of the Association will be attending the Summer Convention at the Burlington Hotel, Boscombe, Bournemouth, in June. Proceedings will open with a reception, followed by dinner and dance, on June 6, and will terminate with a dinner on June 8.

PAPER CONTROL PRICES.—The Board of Trade's Control of Paper (No. 82) Order, which came into force on March 31, 1947, provides increased maximum prices for some base papers for plastics. Copies of the Order (S.R. and O. 1947 No. 504) are obtainable from H.M. Stationery Office, Kingsway, W.C.1, price 3d.

PLASTICS MONOGRAPH No. 17, a new addition to the series issued for purposes of education to members of the Institute of the Plastics Industry and to teachers of recognized course of instruction in plastics, concerns "Mouldings by Compression, Injection and Transfer Methods."

NATIONAL PLASTICS, LTD., announce that they have now acquired the shares of De La Rue Plastics, Ltd., from Thomas De La Rue and Co., Ltd., and as and from April 9, 1947, the company's name will be changed from De La Rue Plastics, Ltd., to British Moulded Plastics, Ltd. Scottish Plastics, Ltd., and Lanarkite, Ltd., formerly subsidiaries of De La Rue Plastics, Ltd., will now become subsidiaries of British Moulded Plastics, Ltd. An offer is being made to the shareholders of Moulded Products, Ltd., to acquire their shares, and a further announcement will be made in due course. The registered office of National Plastics, Ltd., is at Salisbury House, London Wall, E.C.2.

UTILEX, LTD., of Kingston-on-Thames, have issued a small illustrated brochure dealing with the properties and uses of cellulose acetate film. This material has found many applications by virtue of the ease with which it may be joined to itself or to other materials by use of adhesives and cements, or by application of heat and pressure. The film can be printed, using special inks made with quick-drying solvents. An interesting application of both the printing and laminating properties of Utilex film has been the successful application of wood veneer. The natural grain of the wood is photographed and printed on the film by a special technique; panels prepared by this method have the advantage of exactly matching one another. Transparent film in thicknesses of 0.001 to 0.002 inch provides a useful alternative packaging material when viscose film is unsuitable.

DURATUBE AND WIRE, LTD., announce the following appointments in a reorganization of their internal staff: Mr. D. R. Smith to be sales manager for the Home Sales Department, succeeding Mr. R. W. Bishop who has left the company. Mr. John W. Tydeman becomes manager of the Export Department. Mr. A. T. Buss is appointed manager of the Engineering and Design Department, in which capacity he will also be responsible for all publicity. In 1936, Mr. Buss joined the technical staff of Johnson and Phillips, Ltd., of Charlton, where he was responsible for the development of thermo-plastics in the manufacture of electric wires and cables. During the war he served on the Thermo-plastic Technical Committee of the Ministry of Supply.

F. A. HUGHES AND CO., LTD., who have hitherto, under trade names "Cellobond," "Cellomold," "Chlorovene," "Epok" and "Rockite," sold synthetic resins, adhesives, moulding powders and compounds manufactured by their associated company British Resin Products, Ltd., and subsidiary companies, state that part of management and selling staff concerned with plastics will now be transferred to British Resin Products, Ltd., and all sales will be made in the name of that company as from April 1, 1947, at Abbey House, Baker Street, London, N.W.1.

BRITISH RESIN PRODUCTS, LTD.—We are notified that Cellomold, Ltd., Extruded Plastics, Ltd., and Indurite Moulding Powders, Ltd., are to be wound up under a members' voluntary liquidation in order to merge their activities with those of their associated company, British Resin Products, Ltd. All these companies are subsidiaries of The Distillers Co., Ltd., who, in accordance with the national campaign to increase production and provide employment in a development area, are erecting for British Resin Products, Ltd., at Barry, South Wales, a new synthetic resin and moulding powder factory, to manufacture on a large scale the

range of products at present produced by the individual companies. Owing to delays in delivery of materials, plant, etc., some time must elapse before existing production can be centralized at the new site. Meantime, to co-ordinate the activities of these companies with those of British Resin Products, Ltd., the voluntary liquidations will be effective as from April 1, 1947. Arrangements made with the nominated joint liquidators, Mr. H. N. Butler, F.C.A., and Mr. R. D. Brewis, F.C.A., are as follows:—(1) Production will continue as at present at the individual factories, but on and after April 1 all orders to suppliers will be placed by British Resin Products, Ltd. (2) British Resin Products, Ltd., will accept responsibility for the payment of all outstanding trade debts and will accept the liabilities arising from orders outstanding as at March 31, 1947.

BRITISH OVERSEAS AIRWAYS CORPORATION removed their Brislington Experimental Factory to B.O.A.C. Building, Great West Road, Brentford, Middlesex, on March 31.

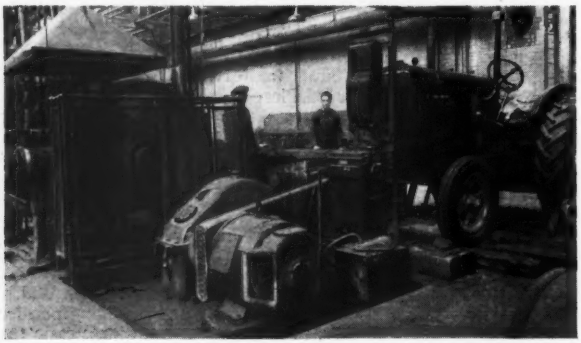
CONRAD PLASTICS CO., carried on by R. H. Creasey, at Dicker Mill, Hertford, together with Conrad Electrical Co., have been acquired by a newly formed £30,000 private company, the Conrad Electrical Co., Ltd. The directors, with R. H. Creasey, are J. G. Williams, H. S. Fox, and M. Banus. Registered office: Royal London House, 17, Finsbury Square, London, E.C.2.

MR. H. V. POTTER, managing director of Bakelite, Ltd., has been nominated as one of the British delegates to the Council of the International Union of Chemistry and also to the General Assembly of the International Union meeting. The nomination was made by the Royal Society, on the recommendation of the National Committee for Chemistry. Both meetings are to be held in London, July 17 to 24. Mr. Potter has also been nominated as representative of the British National Committee for Chemistry at the XIth International Congress of Pure and Applied Chemistry. Mr. Potter was also recently elected to the Grand Council of the Federation of British Industries. He has been associated with the development of phenolic materials for more than 30 years.

MR. S. E. MATTHEWS, F.C.I.P.A., A.R.Ae.S., for many years patent attorney for F. A. Hughes and Co., Ltd. (and Cellomold, Ltd.), has left the plastics side of the company's business and is now in private practice at 14-18, Holborn, London, E.C.1. (Telephone: Holborn 6074.)

MONSANTO CHEMICALS, LTD.—Dr. Scott, chief chemist and research manager of Monsanto Chemicals, Ltd., has announced the promotion of Mr. W. E. Hamer as research superintendent in charge of process investigations, and of Dr. J. W. Barrett as research superintendent in charge of exploratory and applicational research.

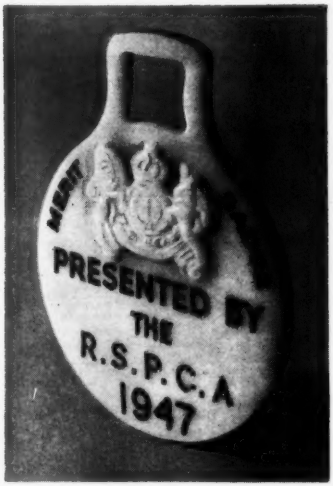
DE LA RUE PLASTICS, LTD., have sent us details of the emergency measures which they took during the recent fuel crisis. By the good offices of the Ford Motor Co. they were able to operate the powder shop, a large part of the tool room, and a section of the finishing shop by substituting the Fordson tractors for normal means of power. The Ford Motor Co. was most prompt in sending both tractors and fuel for them, and it was largely due to this that De La Rue Plastics were able to maintain a certain amount of activity, although not able to do any actual pressing. The company were also fortunate in borrowing two Diesel electric generating sets from the anti-aircraft gun site opposite their factory. Finally, they hired a Diesel air compressor set, enabling them to run a section of the finishing shop on compressed air. Essential office lighting was maintained by use of a small generating set driven by petrol motor.



New Productions from the Moulding Shops

Horse Merit Badges

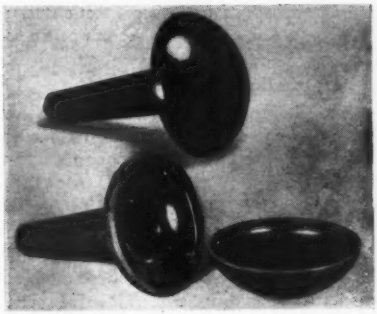
Prior to the War, the R.S.P.C.A. issued metal merit badges, for attaching to the harness, but when it was found that these were unobtainable a badge made in plastics was substituted. These badges are given by the Society at horse shows and parades throughout the country in order to encourage the proper treatment of animals. Normally, they are awarded to the owner or driver of the best cared-for horse. Several



hundred such badges are presented at the London Van Horse Society's Parade, and the London Cart Horse Society's Whitsun Parade. The new plastic badges are moulded by compression from urea material by U.D.A. (Plastics), Ltd., of High Wycombe, Bucks, the mould having been produced in their own toolroom.

Darning Mushroom

The device here illustrated is used to make darning an easier and more congenial task. Our grandmothers commonly used a small ball of agate or other hardstone with a polished surface. Then wood, in the shape of a mushroom (the stalk forming a convenient handle) replaced stone. Now that so many household things are moulded in plastics, it was not surprising to find the darning mushroom joining their ranks. We found this at one of the branches of F. W.



Woolworth and Co., Ltd. From the moulding viewpoint it is interesting on account of the notably deep draw for the handle, which is simultaneously a convenient receptacle for darning needles when the dished top is unscrewed. Moulded in phenolic resin by Ward and Godstone, Ltd., Pendleton, Manchester, and Stadium, Ltd., Ponders End, Middlesex.

Shampoo Spray

An all-plastic spray head that does not spatter the water has become available as a standard bath-room fitting. The robust head fits direct upon rubber hose, from which it is easy to remove for cleaning. This "Tru-Flo" spray, by Rilling-Hills, Ltd., is moulded in black phenolic resin by Universal Plastics, Ltd., Wood Green, N.22; also by De La Rue Plastics, Ltd., now British Moulded Plastics, Ltd. It is ultimately to be produced also with a green mottled finish.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired.

Radio Frequency Heating

Sir,—I have read with interest Mr. Warburton Brown's article on "Recent Developments in Radio Frequency Heating" ("Plastics," March, 1947, page 129).

I cannot, however, agree with the statement "that, with the possible exception of the radio frequency sewing machine for seam welding of p.v.c., these developments (application of radio frequency heating in the plastics industry) have received little attention in the technical Press."

In the first instance, I should like to quote the following twelve articles which have been published, and papers which have been read in the past few years on the welding of thermoplastics by methods other than continuous seam welding.[1-12]

Regarding other applications of radio heating, I should like to mention that a recent Bibliography on Capacity Current Heating, issued by the British Electrical and Allied Industries Research Association,[13] quoted 241 references on applications of R.F. heating, of which the majority apply to the plastics industry.

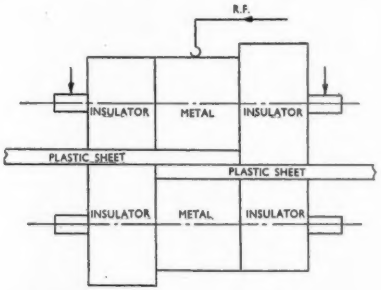
"The Electronic Engineering" Master Index for the year 1945[14] also contains 56 references regarding the application of radio frequency heating to the plastics and other industries.

The statement in the article that these developments have received little attention in the technical Press is, therefore, incorrect.

Furthermore, in fairness to the French engineers and scientists Dufour and Leduc, it should be mentioned that they were the first to carry out preheating of rubber for vulcanizing and other purposes as early as 1935.[15-18] Dufour and Leduc have taken out upwards of thirty patents on this process in all European countries and the U.S.A. These patents cover every aspect of the application of radio frequency heating in the rubber industry.

Regarding the suggestion made in Mr. Warburton Brown's article for an improved model of welding rollers for plastic seam welders, I should like to make the following comments:—

For the convenience of the reader, I repeat the line drawing of the suggested design of a composite roller. As the



author rightly points out, it is necessary to apply heat *and* pressure simultaneously to plastic sheets in order to weld them. Yet I fail to see how pressure can be exerted on the seam with the suggested design, since the incompressible insulated parts of the rollers bear on the unheated and incompressible areas of the sheets adjacent to the welding seam.

It was particularly stated in the original drawing that the difference in radius between the insulating and metal parts of the roller had to be equal to the normal thickness of the plastic sheet. Under these circumstances, although heating between the metal parts will take place, *no* welding will occur, due to the absence of pressure. If, however, the intention was only to use a top roller of this design, then the purpose for which the design was made would not be fulfilled, since unhindered extrusion of the sheets side-

ways can take place near the edges of the lower electrode roller.

Rediffusion, Ltd., H. P. ZADE.
Wandsworth, S.W.18.

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(16) H. Leduc, La radio vulcanisation et les cylindres Caoutchoutés. Rév. Gen. du Caoutchouc, 1936/No. 123/3.
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(18) A. Bloc and G. Genin, Encyclopédie Technologique du Caoutchouc, 1939, Vol. 4, Chap. 3, p. 839. (H. Leduc, La radio vulcanisation.)

Printing Inks for P.V.C.

Sir,—We have noted in your February issue (page 76) an inquiry from Thornton and Ross for printing inks. Although the type of transparent film is not specified, we are writing to draw your attention to a range of liquid products we manufacture for the fabrication printing of polyvinyl chloride sheeting. These include adhesives for seaming and bonding p.v.c. to itself and leather. High-class ladies' evening shoes are being successfully made using our Vinatak 5309 for bonding transparent p.v.c. uppers to the leather.

Pigmented lacquers are made for roller printing, silk screening, and spray-stencilling of p.v.c.

Although developed initially for our own printing requirements, we are now supplying these products to many of the largest textile printers, who have commenced the printing of p.v.c. sheeting.

VINYL PRODUCTS, LTD.
Carshalton, Surrey.

Extruded Sections

Sir,—We were interested when reading your April issue to see Mr. G. Fejér's most comprehensive study of the use of plastics in the furniture trade, but feel that in one particular the uninformed reader might be misled.

On pages 186 and 187 are photographs showing the use of extruded "Rockite" sections for beadings and handles, and on the same pages under the heading, "Extruded Plastics," it is inferred that the American suppliers hold a greater number of stock moulds than do the British. So far as rigid extrusions of the thermoset type, such as "Rockite," are concerned, this is incorrect as the Americans are largely restricted to the thermoplastics. "Rockite" rigid thermoset extrusions are only available from us and our licensees.

BRITISH RESIN PRODUCTS, LTD.
Abbey House,
Baker Street, N.W.1.

Skin Irritation Troubles

Sir,—We write to you in the hope that you may be able to assist us with a current problem which is concerned with the extended use of plastic material.

The enclosed samples, which are thought to be of the polyvinyl series, represent the material involved. We are anxious to know whether such material is likely to prove irritating when in contact with a sensitive skin as a result of friction or chemical action.

We are not wholly competent to deal with such a point ourselves, since our work is more metallurgical in character, and hope our request, addressed to people who specialize in plastics, may bring forth useful information.

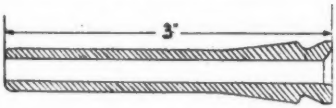
An extended use of plastics is visualized, depending upon whether the fears expressed are real or imaginary. Any assistance you can give us in clearing this point, and also in confirming the type of material, will be greatly appreciated.

MIDLAND LABORATORY
GUILD (1928), LTD.
King Alfred's Place,
Broad Street, Birmingham, 1.

[EDITOR'S NOTE: The sample is almost transparent and, since it contains chlorine, is probably an unpigmented polyvinyl chloride. Under normal conditions, that is, in the absence of heat and other extraordinary conditions, we believe carefully plasticized p.v.c. will not affect delicate skins, but dermatology is not our line of country and we hesitate to make a definite statement. One thing is certain. With the wide use of p.v.c. sheet, especially in the production of children's underwear, the matter should be taken up immediately by an authoritative body. The trouble lies not so much in the basic plastic material, but in the other ingredients, especially softeners or plasticizers that are used to "break-down" the pure p.v.c. to render the latter capable of being calendered. All known plasticizers are volatile to a slight extent and some indeed, for example, tri-cresyl phosphate, should not, in our opinion, be used for any sheet in continual contact with the skin. The manufacturers should be approached with this problem.]

Plastic Textile Pirns

Sir,—We have had considerable difficulty in getting any firm to make moulds and supply us with parts as shown in the accompanying drawing. These have hitherto been made in wood, but we now wish to have them in plastic. Our normal consumption of these parts in wood is about 4,500 gross annually.



We should be glad if you could give us the names and addresses of as many firms as possible who might be able to undertake this work for us. We do not know the type of material used, but we enclose a sample part which has been made locally in a hand-operated mould.

J. AND T. M. GREEVES, LTD.
Forth River Mills,
Belfast.

[EDITOR'S NOTE: Kent Mouldings, Footscray, Kent, have long made these in plastics. Other manufacturers should contact directly with the inquirers.]

The Late Dr. W. H. Carothers

Sir,—In your April issue you published a fitting tribute by Mr. Vivian Stannett to the work of the late Dr. W. H. Carothers. In connection with the use by Carothers of the molecular still in the preparation of super-polyesters, Mr. Stannett remarks:—

> "These would have been impossible to make, using ordinary vacuum distillation, and without the molecular still, Carothers's search for super polymers might well have failed.

This is, perhaps, an interesting speculation, but the first part of the statement is certainly incorrect, for the preparation of super-polyesters without recourse to the molecular still has been reported on several occasions, and, in fact, presents no serious difficulty. Moreover, Carothers himself stated (see p. 160 of "Collected Papers"):—

> "A part of the effect of the molecular still treatment is evidently due to the greatly prolonged time of heating, and it was found later that a similar, if somewhat less-pronounced effect, could be produced by merely heating polyesters such as ethylene sebacate in thin layers of ordinary pressure in a steam of nitrogen for a long period of time, or by bubbling a stream of nitrogen through the molten polyester."

It seems probable that Carothers, having foreseen the possibility of attaining the super-polymeric state, at first somewhat over-estimated the purely technical difficulties involved.

J. R. WHINFIELD.
208, Gloucester Terrace,
London, W.2.

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London W.C.2, price 1/- each.

B.P. 584,906. Application date: 8.10.40. Accepted: 27.1.47.

An Improved Manufacture of Rubber in Cellular Form. G. M. Hamilton. To: Callender's Cable and Construction Co., Ltd.

B.P. 584,929. Application date: 12.4.44. Accepted: 27.1.47.

Improvements in Extrusion Machines for Non-metallic Plastic Materials. A. V. Swallow and A. J. Ensor. To: St. Helen's Cable and Rubber Co., Ltd.

B.P. 584,932. Application date: 24.4.44. Convention date (U.S.A.): 19.8.43. Accepted: 27.1.47.

Improved Apparatus for the Injection Moulding of Plastic Materials. P. A. Norris. To: General Motors Corp.

B.P. 584,933. Application date: 24.4.44. Convention date (U.S.A.): 5.10.43. Accepted: 27.1.47.

Hardenable Compositions containing Aminotriazine-aldehyde Resins. R. R. Harris. To: American Cyanamid Co.

B.P. 584,972. Application date: 12.6.44. Convention date (U.S.A.): 12.6.43. Accepted: 28.1.47.

Composition of Matter comprising Polystyrene. To: Imperial Chemical Industries Ltd.

Light-stable polystyrene composition containing up to 5 per cent. of an aryl glycide ether (i.e., penoxy-propylene oxide) and an organic solvent for polystyrene (benzene or a benzene homologue).

B.P. 584,985. Application date: 23.10.44. Convention date (U.S.A.): 25.10.43. Accepted: 28.1.47.

Polyamide Filaments. To: E. I. Du Pont de Nemours and Co.

Polyamide filaments of improved bend recovery, produced by heating synthetic linear polyamide filaments containing a phenol-aldehyde resin, with an aqueous alkali solution (sodium, potassium or barium hydroxide).

B.P. 584,989. Application date: 25.10.44. Convention date (U.S.A.): 15.1.44. Accepted: 28.1.47.

Improvements in Curing Olefine-Diolefine Co-polymers. To: United States Rubber Co.

Butyl rubber vulcanized with a quinone dioxime, containing tetra alkyl thiuram disulphide to reduce rate of cure.

B.P. 585,033. Application date: 18.3.44. Convention date (U.S.A.): 14.9.43. Accepted: 29.1.47.

Vinyl Halide Polymer and Copolymer Stabilization. To: Wingfoot Corporation.

Stabilizing vinyl-halide resins by incorporating 0.2-10 per cent. of organic or inorganic nitrites or nitrates.

B.P. 585,060. Application date: 11.9.44. Convention date (U.S.A.): 9.9.43. Accepted: 29.1.47.

Improvements in or relating to Heat-Convertible Adhesive Compositions and applications thereof. To: E. I. Du Pont de Nemours and Co.

Heat-convertible adhesive composition for bonding natural and synthetic rubber to rayon, nylon and cotton, consisting of cyclized rubber and a phenol-formaldehyde or resorcinol formaldehyde resin dissolved in an organic solvent.

B.P. 585,073. Application date: 7.12.44. Accepted: 29.1.47.

Improvements relating to the Manufacture of Xylene-Styrene Condensation Product. T. G. Woolhouse and W. Lunn. To: Dorman, Long and Co., Ltd.

B.P. 585,083. Application date: 28.2.45. Accepted: 29.1.47.

Composition comprising Polymeric Materials. W. F. Smith and H. G. White. To: Imperial Chemical Industries, Ltd.

Compositions containing organic diisocyanate modified polyesters or polyester amides and acetals of polyvinyl alcohol.

B.P. 585,088. Application date: 29.11.43. Convention date (U.S.A.): 6.4.43. Accepted: 30.1.47.

Improvements in the Manufacture of Rubber Hydrochloride and Packaging Material and Packages made therefrom. To: Wingfoot Corporation.

Rubber hydrochloride film having a low permeability to moisture vapour, prepared from deproteinized latex.

B.P. 585,096. Application date: 28.8.44. Convention date (U.S.A.): 26.8.43. Accepted: 30.1.47.

Improved Process for the Polymerization of Esters of Acrylic Acid and Derivatives thereof. To: Imperial Chemical Industries, Ltd.

Casting of acrylic esters into articles of substantial cross sections. The process involves polymerizing of the acrylic acid ester in the presence of benzoyl peroxide, sulphur dioxide and an acetal until a syrup is formed which is poured into a mould. Final polymerization yields castings free from voids or bubbles.

B.P. 585,164. Application date: 9.5.44. Convention date (U.S.A.): 17.8.43. Accepted: 31.1.47.

Process and Apparatus for Producing Continuous Sheet of Bioxially Oriented Organic Polymer. F. E. Wiley R. W. Canfield, R. S. Jesionowski and J. Bailey. To: Plax Corporation.

B.P. 585,179. Application date: 21.8.44. Convention date (U.S.A.): 21.8.43. Accepted: 31.1.47.

Photopolymerization Process. To: Imperial Chemical Industries, Ltd.

Photopolymerization of organic compounds containing at least one $CH_2=C>$ group directly attached to a negative group (styrene is particularly mentioned) and 0.01–5 per cent. of an organic disulphide by irradiation with light of a wavelength between 2,800-4,000 Angström.

B.P. 585,186. Application date: 6.10.44 Accepted: 31.1.47.

Improvements in and relating to the Formation, Reinforcement or Sealing of Joints for Fibrous Materials. G. C. Tyce. To: Imperial Chemical Industries, Ltd.

Bonding or sealing of joints of fibrous materials (asbestos board, fibre board, plywood, etc.) by pressing over the joint a strip of fibrous material coated with polythene and effecting a bond by heat sealing of the polythene.

B.P. 585,205. Application date: 22.12.44. Accepted: 31.1.47.

Curing of Polymeric Materials. D. A. Harper and W. F. Smith. To: Imperial Chemical Industries, Ltd.

Curing of diisocyanate modified polyester amides in uniform mixture with a cellulose derivative (cellulose acetate, nitrocellulose).

B.P. 585,215. Application date: 13.3.44. Convention date (U.S.A.): 14.9.43. Accepted: 3.2.47.

Vinyl Halide Copolymer Stabilization. To: Wingfoot Corporation.

Stabilization of vinyl halide copolymers with alkali sulphides.

B.P. 585,289. Application date: 14.2.45. Accepted: 4.2.47.

Improvements relating to the Production of Moulded Articles with variously coloured Areas thereon. H. A. M. Winter. To: Hornflowa, Ltd.

Method of producing multi-coloured buckles, buttons, brooches, etc., by spraying on the partly moulded article a covering pigment. A soluble dye may then be sprayed on the surface so treated and the whole product finally set by a further moulding operation.

B.P. 585,385. Application date: 4.6.45. Accepted: 5.2.47.

Improvements in or relating to the Manufacture of Expanded Thermoplastic Materials. A. Cooper. To: Expanded Rubber Co., Ltd.

See also B.P. 580,743. Expanded polyvinyl chloride or copolymers thereof.

B.P. 585,395. Application date: 21.2.44. Accepted: 6.2.47.

Improvements in or relating to the Production of Hollow Articles consisting of or comprising Thermoplastic Resins. G. C. Tyce and R. L. Stevens. To: Imperial Chemical Industries, Ltd.

Centrifugal casting of hollow round articles (tubes, pipes, etc.) by spinning thermoplastic powders (polythene, polystyrene, etc.) in a suitable mould which is heated from the outside, until the resin is molten and continuing the spinning during the subsequent cooling period. This method may also be used for the production of sheets; in this case a cylinder of thermoplastic material is split open lengthwise and the sheet flattened under the application of moderate heat.

B.P. 585,396. Application date: 10.3.44. Convention date (U.S.A.): 10.3.43. Accepted: 6.2.47.

Improved Process for the Manufacture of Polymeric Materials. To: E. I. Du Pont de Nemours and Co.

Catalytic polymerization of monoolefinic compounds by contact with an amine oxide catalyst (trimethylamine oxide hydrate) at elevated temperatures and high pressures.

B.P. 585,400. Application date: 25.4.44. Accepted: 6.2.47.

Improved Manufacture of Organo-Siloxanes. To: Corning Glass Works.

Polymerization of products obtained by hydrolysis and dehydration of organo-silicon compounds.

B.P. 585,403. Application date: 1.5.44. Convention date (U.S.A.): 15.4.43. Accepted: 6.2.47.

Improvements in and relating to Injection Moulding Machines. H. F. McMillan. To: Hydraulic Press Mfg. Co.

B.P. 585,420. Application date: 8.8.44. Accepted: 6.2.47.

Improvements in or relating to Low-temperature Catalytic Polymerization Processes. To: Standard Oil Development Co.

Polymerization catalyst comprising a Friedel-Crafts catalyst in which the halogen is partly replaced by oxygen or hydroxyl groups, dissolved in a low-freezing hydrocarbon or alkyl halide.

B.P. 585,434. Application date: 1.11.44. Accepted: 6.2.47.

Improvement in or relating to Catalytic Polymerization Processes. To: Standard Oil Development Co.

Polymerization of unsaturated hydrocarbons. Refers particularly to polymerization reactions with a starting-up period during which the catalyst does not exhibit its normal activity.

B.P. 585,423. Application date: 28.8.44. Convention date (U.S.A.): 26.8.43. Accepted: 6.2.47.

Aqueous Dispersions of Vinyl Acetate Polymers. To: Imperial Chemical Industries, Ltd.

Polymerization of vinyl acetate in an aqueous solution containing vinylacetate, a catalyst (benzoyl peroxide), a stabilizing agent and a dispersing agent (a water soluble sulphate ester of an aliphatic alcohol and a cationic surface active agent).

B.P. 585,435. Application date: 7.11.44. Accepted: 6.2.47.

Improvements in or relating to the Catalytic Polymerization of Unsaturated Hydrocarbons. To: Standard Oil Development Co.

See also B.P. 585,434. Refers to the polymerization of isobutylene for the production of synthetic rubber.

B.P. 585,504. Application date: 5.2.45. Convention date (U.S.A.): 5.2.44. Accepted: 7.2.47.

Improvements in or relating to Polythene Compositions: To: E. I. Du Pont de Nemours and Co.

Heat stabilization of polythene with acetone-diphenyl-amine condensation products (0.005-5 per cent. by weight).

B.P. 585,550. Application date: 28.2.45. Accepted: 11.2.47.

Improvements in or relating to Water Dispersible Compositions containing Synthetic Resinous Condensates. H. F. Rance, G. F. Glover and Miss E. J. Pritchard. To: Wiggins Teape and Co. (1919), Ltd.

See also B.P. 582,157.

Covers the same ground as B.P. 582,157, the difference being that the urea is wholly or partly replaced by melamine.

B.P. 585,576. Application date: 6.9.43. Accepted: 12.2.47.

Improvements in or relating to the Moulding of Lenses, Prisms and like Optical Elements from Plastics. J. Johnson.

Refers particularly to methyl methacrylate and polystyrene optical components. The plastic blanks are preheated in such a way that only the outer layer or skin reaches the softening temperature whilst the rest remains solid. The flow during moulding is, therefore, confined to the outer layer or skin.

B.P. 585,577. Application date: 1.11.43. Convention date (U.S.A.): 6.10.42. Accepted: 12.2.47.

Improved Water-Soluble Phenolic Adhesive Resin. C. F. Van Epps. To: I. F. Laucks Inc.

Water-soluble phenolic resin especially suitable for making boil-resistant hot-pressed plywood, produced by cooking under refluxing conditions a phenolic material, formaldehyde and an alkali, and continuing the cooking process until the mixture reaches a viscosity of between 230 and 460,000 centipoises.

B.P. 585,580. Application dates: 23.11.43, 25.1.44, 18.12.44. Accepted: 12.2.47.

Improvements in the Manufacture of Lenses from Plastic Materials. J. Johnson.

To a core of solid thermoplastic material such as polymethyl methacrylate a liquid film or coating of a transparent thermoplastic or thermosetting abrasion resisting material is applied and the whole body subsequently moulded in dies which have optically accurate surfaces. The film or coating may consist of one of the following cross-linked resins: allyl methacrylate, allyl chloroacrylate, diallyl oxolate, glycol dimethacrylate, allyl crotonate or diallyl phthalate, which may be applied to the solid core by dipping or spraying.

B.P. 585,582. Application date: 25.2.44. Convention date (U.S.A.): 4.9.42. Accepted: 12.2.47.

Improvements in Polymerizable Trichlorostyrene and Polymers and Copolymers thereof. To: The Mathieson Alkali Works.

Production of trichlorostyrene by contacting chloroethyl trichlorobenzene in the vapour state with activated alumina or fuller's earth.

B.P. 585,589. Application date: 2.5.44. Convention date (U.S.A.): 30.3.43. Accepted: 12.2.47.

Improvements in Organo-Siloxanes and Methods of making them. W. H. Daudt. To: Corning Glass Works.

Refers to organo-siloxanes produced by interaction of two or more different organo-siloxanes at least one of which is substantially free of hydroxide groups.

B.P. 585,621. Application date: 11.10.44. Convention date (U.S.A.): 11.10.43. Accepted: 13.12.47.

Improvements in or relating to Apparatus for Coating the Interiors of Containers with flowable Material. To: Continental Can Co. Inc.

Apparatus for coating the interior of containers with a flowable material by flooding the container with such material, subsequently draining off any surplus so as to leave an adherent coating on the interior wall surfaces.

B.P. 585,625. Application date: 25.10.44. Convention date (U.S.A.): 25.10.43. Accepted: 13.2.47.

Polymeric Materials. To: E. I. Du Pont de Nemours and Co.

Manufacture of articles from polytetrafluoroethylene by heating the latter at a temperature of 50-500 degrees C. in an oxidizing atmosphere and subsequent moulding of the articles from the hot polymer. It is an advantage to spread the material over as large a surface as possible whilst heating. This process yields a material which is not liable to discoloration.

B.P. 585,626. Application date: 12.8.43. Convention date (U.S.A.): 2.8.42. Accepted: 14.2.47.

Improvements relating to the Hydrolysis of Organo-Silicon Halides. To: The British Thomson-Houston Co., Ltd.

Hydrolizing of organo-silicon halides (methyl silicon halides) in admixture with silicon tetrachloride, yielding liquid heat hardenable organo-silicon resins.

B.P. 585,627. Application date: 17.8.43. Convention date (U.S.A.): 21.8.42. Accepted: 14.2.47.

Improvements in and relating to Methods of Preparing Silicon Resins. To: British Thomson-Houston Co. Ltd.

B.P. 585,628. Application date: 8.2.44. Convention date (U.S.A.): 8.2.43. Accepted: 14.2.47.

Improvements in and relating to Silicon Resins. To: The British Thomson-Houston Co., Ltd.

B.P. 585,688. Application date: 26.10.43. Convention date (U.S.A.): 10.11.42. Accepted: 18.2.47.

Improvements in or relating to the Production of Moistureproof Cellulosic Sheets or Film. To: British Cellophane, Ltd.

B.P. 585,697. Application date: 13.6.44. Convention date (U.S.A.): 21.9.43. Accepted: 20.2.47.

Improvements in the Preparation of Aqueous Dispersions of Vinyl Chloride Polymers. To: Dispersions Process Inc.

Preparation of aqueous dispersions of vinyl chloride polymers which are substantially free from OH groups by mixing with the polymer another polymer containing OH groups, a plasticizer and a hydrophilic colloidal dispersing agent. To the plasticized mix water is added and mixing continued until the polymer becomes uniformly dispersed in the aqueous medium.

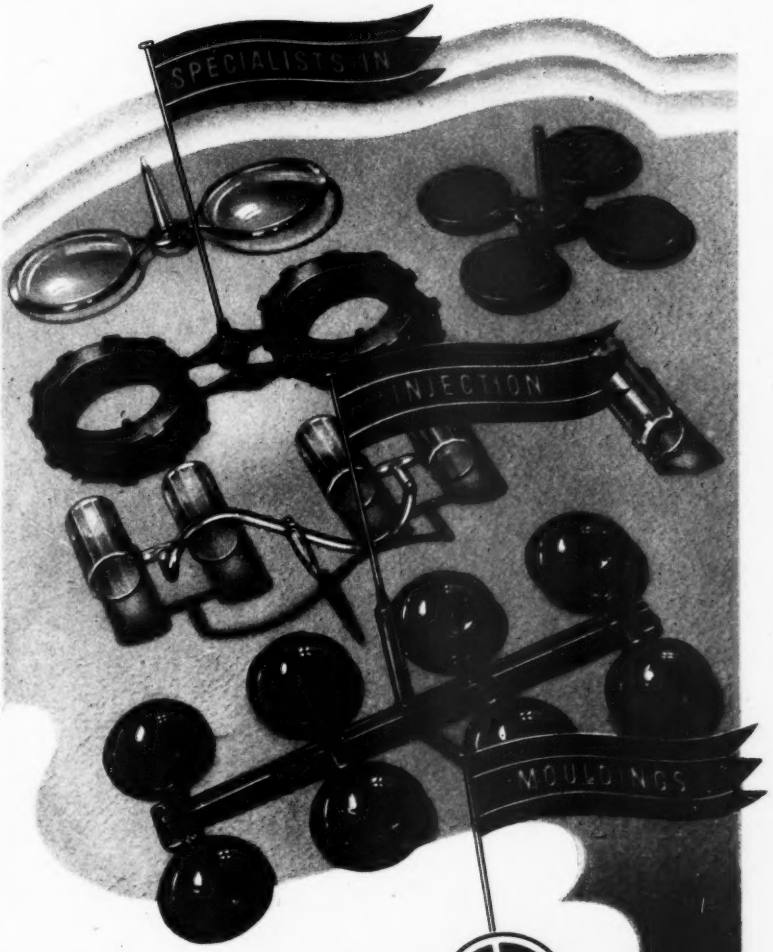
B.P. 585,711. Application date: 18.8.44. Convention date (U.S.A.): 20.8.43. Accepted: 20.2.47.

Treatment of Halogenated Polymerizing Products of Ethylene. To: E. I. Du Pont de Nemours and Co.

Curing of halogenated solid polymer and interpolymers of ethylene by heating a mixture containing a halogenated solid ethylene polymer or interpolymer, sulphur, a metal oxide and a vulcanization accelerator and a filler, to at least 100 degrees C. for at least 15 minutes. Examples of metal oxides given: zinc oxide, magnesium oxide, calcium oxide, barium oxide and mixtures thereof. The products so obtained have high solvent resistance, high softening points and high tensile strengths.

B.P. 585,713. Application date: 19.9.45. Convention date (U.S.A.): 6.12.44. Accepted: 20.2.47.

Improvements in the Production of Cellulose Esters. A. D. Clark and W. F. Reichardt. To: American Viscose Corp.



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Chemistry and Technology of the Organic Isocyanates (Contd.)

By S. H. Pinner,
B.Sc., F.R.I.C.
(Research Chemist, BX Plastics, Ltd.)

In this concluding instalment, the author proceeds to discuss the applications of isocyanates to high polymer technology. He deals first with the formation of polyurethanes.

THE development of the polyurethanes by I.G. Farbenindustrie was first undertaken in 1937.[7, 69, 71, 72] Considerable advances were made during the war[7, 73] and investigations also began elsewhere.[83, 90]

A wide range of polyurethanes made from different polyfunctional reactants was investigated. The products had melting points varying from 183 degrees-255 degrees and densities from 1.15-1.40. The purely aliphatic reactants gave the most satisfactory material. Greater transparency appeared to be exhibited by polyurethanes with odd numbers of $-CH_2$-groups between urethane linkages. Aromatic di-isocyanates gave polyurethanes of little value. They could not be stretched, had higher melting points and were thermally unstable. Mixed aromatic aliphatic polyurethanes were found suitable as a substitute leather. Copolymers or condensation products of mixed glycols and mixed di-isocyanates were also examined. They were found to be more soluble and more fusible than uniform linear polyurethanes, as may be expected. Polyurethanes from long-chain di-isocyanates and glycols generally had low melting points, too.

Polyurethanes could, of course, be made by other means, e.g., by condensing diamines with glycol chlorocarbonic esters, with bis-carbamic esters of diamines and with diphenyl carbonate, and by polymerizing amino chlorocarbamic esters,[38] but none of these methods were able to compete with the original methods involving isocyanates.

An injection polymer of molecular weight 10,000 and known as Igamid or Perlon U was made by condensing 1:4 butylene glycol with 1:6 hexamethylene di-isocyanate. The molecular weight was controlled by the relative proportions of di-isocyanate, diol and solvent in the reaction mixture, by the temperature, and also by the presence of impurities. Condensation will take place at room temperature, but it was customary to use heat and a solvent.

It was important for the di-isocyanate to be 99.5-100 per cent. pure and for the butylene glycol to have a sharp melting point of 19-19.2 degrees C. and a water content not exceeding 0.05 per cent. The butylene glycol was added to a mixture of chlorobenzene and dichlorobenzene in a stainless-steel reaction vessel. After warming to 60-70 degrees, the di-isocyanate was added. The temperature rises to the reflux point, and the reaction must be controlled by cooling. Condensation was complete in 5-6 hours, the polyurethane separating out as a fine, sandy powder. The product was filtered, washed with chlorobenzene and steam-distilled to remove solvent. The polyurethane was then dried at 65 degrees C. and 30 mm. Hg pressure.

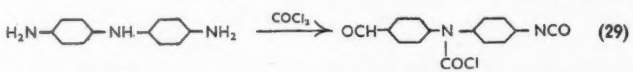
Perlon U is said to be similar to nylon in many respects and somewhat superior in water, reagent and solvent resistance, wet hardness, dimensional stability, electrical properties and insensitivity to oxygen, but inferior in heat resistance.

Fibres

This polymer could also be used for the manufacture of bristles and filaments. In making fibres, the material was cold-drawn 400 per cent. This operation had to take place within 4 hours of spinning owing to rapid crystallization, although

in cases of emergency the crystallization of a batch could be arrested by refrigeration. The stretched material exhibited a very sharp crystalline X-ray pattern and had a tensile strength of 7.5 gms. per denier, as compared with 3.5 gms. per denier for natural silk. The water sorption was exceptionally low, a figure of 0.5 per cent. weight gain after 10 days' immersion at 20 degrees C. being obtained.[6] The material was translucent, like nylon, and could be dyed with dyes suitable for cellulose acetate.

A novel type of fibre was made from diamino diphenylamine. A stable carbamyl chloride was formed by phosgenation (reaction 29). This could undergo condensation with glycols to give linear polyurethanes. The drawn fibre could then be reacted with hexamethylene diamine and cross-linked via the acid-chloride grouping. The softening point could be raised 60 degrees C. by this means.[33]



(29)

Synthetic Rubbers

One of the more successful applications of isocyanates in Germany involved the production of synthetic rubbers (J-rubber). These were made by reacting waxlike polyesters (made from glycols containing small proportions of trioxy-compounds) with polyisocyanates in the presence of a plasticizer (dibutyl phthalate) for 3 hours at 110 degrees C., when cure is complete. The product has outstanding tear resistance and solvent resistance, but has poor low-temperature characteristics. Processing prior to curing was facilitated by the use of isocyanate generators.[8]

Moulding Powders

A process has been described[7] for making moulding powders from di-isocyanates. These are mixed with polyhydroxy compounds and a large proportion of filler, and the reaction is carried out on hot rolls, as in the Bakelite technique. Owing to the delicacy of control necessary, it was preferred to use slow-reacting di-isocyanates, such as pp'-dixylylidene-methane di-isocyanate. Moulding requires 5-10 minutes at 140-160 degrees. The products were superior to Bakelite in flow characteristics, alkali resistance, electrical resistance and, more particularly, elasticity, as measured by impact-bending strength.[7] The possibility also exists of cold-forming these compositions and then bringing about cure by baking in ovens.[7]

Coatings

Another important outlet for the polyurethanes was in the adhesive and coating field. Suitable types were made from polyfunctional reactants to allow cross-linking to occur. More commonly, the di-isocyanates were combined with polyhydroxy compounds, such as polyesters and alkyds.[5] To improve control of the process, isocyanate generators were used, i.e., addition compounds of isocyanates with some volatile component, which set free isocyanates when heated.[8] Alternatively, condensed di-isocyanates were used; e.g., dimers and trimers. The polyurethane was formed on the surface, cure requiring about 2 hours in the cold. These coatings are said to be glossy and weather resistant, and to have good electrical properties and low permeability to gases. Since they could be formed at low temperatures, they were suitable for coating delicate surfaces, such as paper and textiles.[8] Compared with phenol resins, these lacquers and glues were more alkali resistant and more elastic. Similar compositions were used for laminating wood, with the addition of tri-isocyanates to increase cross-linking capacity. German Army anti-gas capes were made with paper impregnated with these lacquers. They were more resistant to mustard gas than rubber proofings.[8] The lack of stability of lacquer solutions was a problem solved by the use of

stabilizers, e.g., azo-dyes and thiourea, and by the use of "masked" di-isocyanates, i.e., isocyanates reacted with phenol-malonic esters, phenyl methyl-pyrazolone, diphenylamine, etc. Nevertheless, these lacquers had to be used within a day.

Films and Foils

A mixed polyurethane made from hexamethylene di-isocyanate, *p*-phenyl, ω propyl di-isocyanate, butylene glycol and methyl hexane glycol, was found to be suitable for making films and foils.[6]

Expanded Plastics

A composition containing tolylene di-isocyanate, adipic acid and trimethylol propane became of interest as an expanded material (Moltoprenes). The carboxylic acid reacted with the isocyanate to generate carbon dioxide, which foamed the composition. By the addition of water (up to 2 per cent.), the specific gravity could be reduced to 0.045. The addition of acetone or methylene chloride, or paraformaldehyde, as a foaming agent led to still reduced densities (circa 0.02). To improve strength, aluminium powder was added, and the addition of trichloroethyl phosphate reduced flammability.[8] The mixture foamed spontaneously and the reaction was complete in about an hour. It was the custom to after-cure the material for 24 hours at 100 degrees C. The cells are said to be non-intercommunicating and all of the same size.

Leather Substitute

A useful leather substitute was made from a composition containing butylene glycol, methyl hexanediol and hexamethylene di-isocyanate and plasticized with benzenesulphon-methyl amide. This was claimed to have excellent tear resistance and water resistance and to be a far better leather than polyamide leather.[8]

Other Polymers from Isocyanates

Allyl alcohols react exothermically with di-isocyanates to give dicarbamic esters, which can then be polymerized by peroxides to give a rubbery material.[90] The copolymerization of unsaturated isocyanates, such as vinyl isocyanate, with methyl methacrylate and styrene gives rise to durable water-repellent resins,[18] which can also be used for conferring water-repellent coatings on textiles. Polyureas formed by reaction between di-isocyanates and diamines have been claimed for use as fibres,[23, 69] but have since proved insufficiently resistant to water to be of any value. A number of resinous condensation products have been made by reaction between alkylene imines and isocyanates.[39, 65] A resin made by condensing a cyclic imine, an aromatic isocyanate and carbon disulphide is claimed to confer wool-like properties, when used to impregnate artificial and vegetable fibres.[65]

Uses of Isocyanates in Treating Polymers

Owing to the reactivity of isocyanates with compounds containing active hydrogen atoms, a number of polymers are susceptible to treatment with isocyanates with advantageous results. To mention only a few applications, isocyanates can be used to augment the molecular weight of polyesters, polyamides or mixed polymers, they can be used for bonding different polymers to one another, and they confer water-repellency in reacting with hydrophilic groups. A novel use of the cross-linking polyisocyanates consists of fastening the plasticizer to the polymer molecule. Tartrate plasticizers in cellulose acetate can be rendered involatile and non-extractable by this means without impairing the plasticization.[8]

Products of condensation polymerization, such as polyesters and polyamides, are generally of low molecular weight compared with addition polymers. The molecular weight is important inasmuch as it influences such properties as resiliency and tensile strength. Normally, the molecular size is increased by prolonged heating, preferably in a molecular still. This is an expensive process. It is

now possible to bring about the same effect if relatively low-polymeric intermediate condensates are treated with about 10 per cent. of a di-isocyanate for 10-45 minutes at 150-250 degrees C.[14, 54] If too much di-isocyanate is present, the reaction gives rise to a cross-linked infusible polymer. In some cases, cross-linked products can be improved in physical properties and rendered soluble in a standard benzene-alcohol solution by milling or otherwise mechanically working,[60] but it is generally desirable to use the correct proportion of the di-isocyanate. Isocyanate-treated polyesters and polyester-amides are useful for conversion into filaments and bristles,[14] and for insulation purposes.[22] If they are further milled with sulphur and a vulcanization accelerator, one obtains infusible elastic hard-rubber substitutes.[55] Alternatively, formaldehyde, nitro-compounds, peroxides or quinone oximes may be used as curing agents.[56]

Alkyd resins are likewise vastly improved by reaction with di-isocyanates. The modified resins harden much sooner on baking than the unmodified resin and give a more durable finish.[29, 31] The reaction between the alkyd resin and the di-isocyanate is catalyzed by cobalt naphthenate and allied siccative salts.

Polyesters are by no means the only polymers which may be improved by treatment with isocyanates. Increased toughness and water resistance are conferred on polyvinyl resins by similar means.[30] Heating hydroxylated vinyl compounds, such as polyvinyl alcohol and acetals, and copolymers of glycol mono-acrylate and styrene[40] for 1 hour at 100 degrees C. yields improved coating adhesives and moulding compounds.[21] Polyethers can be so treated with beneficial results,[30] and products of improved water resistance and hardness, and decreased cure time may be obtained by heating phenol-formaldehyde and urea-formaldehyde resins with di-isocyanates in the presence of cobalt or benzoyl peroxide.[28]

Water-repellency Treatment

Attempts have been made to reduce the water resistance and to increase the stiffness of polyamides by treating them in bulk.[15] The results are an interesting reflection of the reactivity of the isocyanates. The polyamide article may be treated in two ways: either it is immersed in the pure agent at 140-180 degrees C., or it is immersed in a solution of the isocyanate and baked on removal at 180-220 degrees C. If the polyamide article is exhaustively dried before treatment, improvements in water resistance and stiffness result, but there is no increase in durability. If, on the other hand, undried polyamides are treated, they become more durable. This suggests that, in the absence of water, only one $-NCO$ group of the di-isocyanate reacts, and there is no cross-linking to confer durability. Indeed, it is recommended that lauryl and stearyl mono-isocyanates be used if it is desired to improve water resistance only. The decrease in water sorption of polyamide bristles, brought about by treatment with hexamethylene di-isocyanate, is, in any event, not very marked, a reduction of 25 per cent. being the maximum claimed. This is evidently due to the lack of reactivity of isocyanates with the peptide backbone of polyamides.

Bonding Agents

One of the most remarkable uses of the isocyanates is that of bonding dissimilar polymers together, of bonding rubber to metals, glass, porcelain, etc., and of bonding metals to metals. Triphenylmethane-p-tri-isocyanate has been used for attaching rubber to steel tank treads, the bond being stronger than the rubber itself. This process was so successful in Germany that it replaced the old brass-plating technique.[8] The addition of 2 per cent. of this isocyanate to synthetic rubber promotes excellent adhesion to the tyre cords.[73] Cyclized rubber, the usual bonding agent for rubber to metals, is greatly improved as an adhesive by adding a di-isocyanate.[92] Bonding dis-

similar polymers with di- and tri-isocyanates is usually effected under heat and pressure, 75-200 degrees C. being the customary temperature range, but even room temperatures may be employed. Catalysts recommended are the well-known "metallic driers," e.g., cobalt, manganese salts of oleic, stearic acid, etc., in the proportion of 0.01-1 per cent. of the isocyanate.[50]

Treatment of Textiles

Isocyanates have also been used for the treatment of textiles and fabrics based on cellulose. The resultant products are improved in heat resistance, water resistance and dye affinity. Di-isocyanate-treated acetate rayon is said to be resistant to melting under a hot iron.[73] Long-chain mono-isocyanates, such as stearyl and palmityl isocyanates, are specified for conferring water-repellency on textiles.[26, 44, 45] The procedure is to steep the cloth in an aqueous emulsion of the isocyanate, and then, after expressing the excess liquid, to bake at 80-160 degrees, shorter schedules being required at higher temperatures. Both mono- and di-isocyanates have been claimed for modifying the dye affinity of cellulose-based yarns.[9, 27, 86] If dried cotton yarn is reacted with phenyl isocyanate in the presence of pyridine at 80 degrees for 4 hours, it increases in weight to the extent of 30 per cent. and may then be strongly dyed with basic dyestuffs without a mordant.[86] To enhance the dye affinity of regenerated cellulose fibres, they may be immersed in a 10 per cent. solution of a di-isocyanate in benzene, dried and baked for 1 hour at 140 degrees C. Alternatively, the fibres may be boiled with a 3 per cent. solution in xylene.[27] In certain cases, treatment of fibres with isocyanates confers a wool-like finish.[66, 70]

Treatment of Proteins

Di-isocyanates are effective as tanning agents for leather and have been employed in place of natural tanning agents with a considerable reduction in time for the operation. Fraenkel-Conrat et al have studied the combination of a wide range of commercial proteins with isocyanates[35] and achieved some success in reducing the water affinity of proteins.[82] Treated proteins were reported to have greater compatibility with hydrophobic plasticizers.

Attempts have been made to develop moulding compositions from casein or albumen and isocyanates,[67, 68] and from casein, alkylene imines and isocyanates,[32] but no commercial materials have resulted.

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BRITISH INDUSTRIES FAIR

(Continued from page 234.*)*

Cups and saucers, moulded in urea formaldehyde in a range of colours, are exhibited by Sterling Plastics, Ltd.

Extruded p.v.c. and polythene are featured on the stand of Tenaplas, Ltd. Fig. 9 shows a pair of braces and suspenders made entirely of Tenaplas thermoplastic extrusions, consisting of ¾-in. multi-beaded "Tenatape," for use with the braces, together with the Tenaplas patent brace end, also ¾-in. plain "Tenatape," as used in conjunction with the suspenders. A further point of interest is the plastic ring for the back of the brace, produced by Tenaplas and patented by Kenrick's, of Nottingham, who fabricate both these articles.

Cellulose-acetate products, including laminating film and seamless transparent containers, are seen at the stand of Utilex, Ltd.; here also is a range of materials for lampshades.

Under the trade name "Vinatex," Vinyl Products, Ltd., have a display of calendered and post-processed (i.e., pressed, polished, embossed, printed and spray-printed) p.v.c. sheeting, together with examples of objects fabricated therefrom, such as hand-bags, macintoshes, shoes, curtaining, etc. They also show "Vinatex" p.v.c. paste, with examples of leathercloth prepared from it, and specimens of its application as a casting and low-pressure medium for such objects as dolls, mats, etc. Separate displays are made of "Vinalak" inks for printing on p.v.c., and synthetic-resin emulsions for leather finishing, manufacture of synthetic thermoplastic boarding and treatment of fabric.

Vulcanised Fibre, Ltd., are showing rail-track insulations, as used extensively on London's "Underground" and other electrical systems.

The Microscopic Examination of Plastic Materials

VI.—Mouldings (Fillers)—(f) Fibrous Materials

By J. H. WREDDEN, F.R.M.S.
(Chief Chemist, Igranic Electric Co., Ltd.)

HAVING examined a material which may be regarded as a fibrous filler, in the form of sulphite woodpulp, let us turn our attention to the potentialities latent in the regular fibres of commerce, although it should be pointed out that as things are at present, these materials are almost all expensive to the point of being economically unsound for use as filling materials. However, it is proposed to examine a few of the better-known fibres, because it is hoped that at some time in the future it may be possible to use them for this purpose, as there would appear to be a likely source of supply in the waste materials produced by the various industries using commercial fibres, for it should be remembered that in this waste there is a considerable quantity of fibre for which, at the moment, there are few, if any, outlets.

It is proposed to deal only with those fibres of vegetable origin, as the animal fibres are unsuitable for fillers owing to their poor resistance to heat. The vegetable fibres, on the other hand, have the same resistance as the wood materials and therefore are quite suitable.

In considering fibres generally it should be noted that all vegetable fibres are basically composed of cellulose, although as we have seen this may be subject to considerable modification, both morphologically and chemically. Vegetable fibres are obtained from various parts of the plant. For example, they might take the form of hairs, such as the cotton fibre, which may be regarded as anatomical or histological fibres; that is to say, each fibre consists of a single cell or histological element. On the other hand, they might originate in the phloem tissue of dicot plants, in which case they are bast fibres, such as jute, hemp, flax, ramie, etc. Other fibres have their origin in the fibro-vascular bundles from the leaves of monocot plants; examples of these are sisal, hemp, coconut fibre, etc.

From this it will be obvious that fibres in general may be classified in the following divisions:—

(I) Those consisting of a simple cellular structure, exemplified by seed hairs, etc.

(II) (a) Bast fibres obtained from inner fibrous bark of dicot plants and consisting of a number of elongated phloem cells whose ends overlap so as to form a filament en masse, their utility to the plant being to give strength and elasticity to the stem structure.

(b) Xylem tissue fibres, such as those obtained by the maceration of wood, such as the sulphite woodpulp already dealt with.

(c) Fibres derived from the structural parts of the stem and leaves of monocot plants, which occur in the phloem of the vascular bundles.

It will be appreciated that there exists a considerable structural difference between the two main groups. The first consists of relatively short units composed of one cell, thus seed hairs are botanically known as plumose fibres and are more usually composed of a unicellular structure with only one solid apical end, the other end being fixed to the seed from which it arises. They are covered

externally with a characteristic thin cuticle which differs somewhat from the remaining cellulose as it is not dissolved by sulphuric acid. As the cell walls are irregular in thickness and the fibres possess a bore or lumen, the dried fibre takes the familiar tape-like form exhibited by cotton, the lumen appearing as a line or slit when the fibre is seen in cross section.

Seed hairs are divided into three classes based on their morphology. One class consists of the true seed hair, such as cotton, where each individual hair consists of a single cell and generally exhibiting one tapered end, the other being broken at the root where it was attached to the seed. The second class of hair is made up of a series of cells forming a continuous fibre, and the class as a whole includes the epidermal hair from certain ferns and such-like plants. These hairs are of little value for use in materials requiring any mechanical strength, although used for stuffing. The third class consists of hairs made up of several series of cells, typified by such fibres as cotton grass and elephant grass.

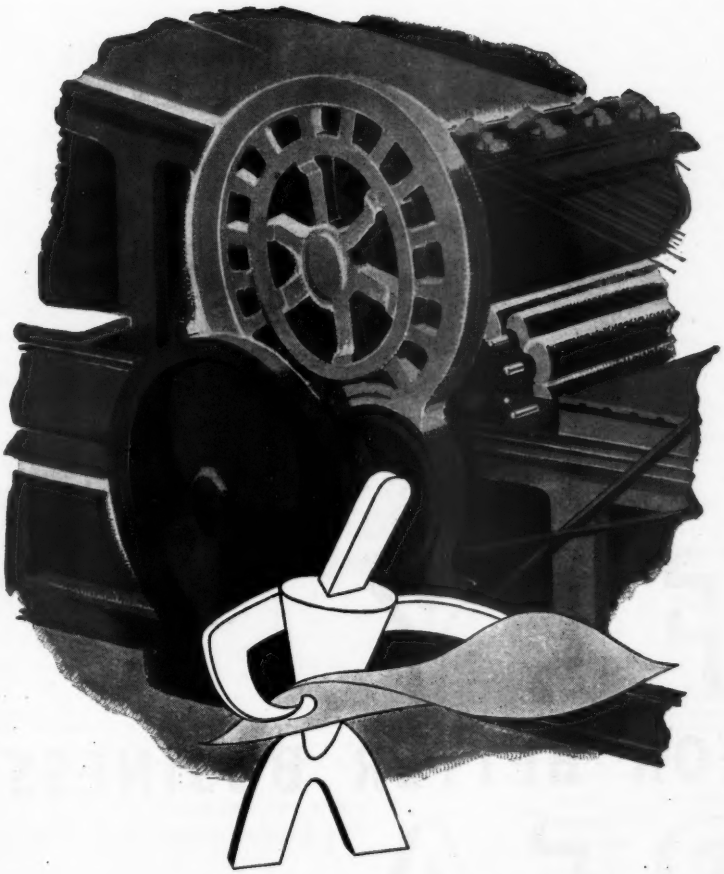
In view of the successful use of seed hair, in the form of cotton, as a filler, it would perhaps be as well to see how many varieties there are, as the number of alternatives to cotton are numerous and should not be ignored. Thus, of the seed hairs covering seeds, we have the varieties of cotton; of those contained in the flower we have species such as *typha* and *eriophorum*, and of those lining the fruit, types such as *ochroma*, *bombax*, *eriodendron*, etc.

The seed hair fibres vary in their morphology to some extent. In some cases the cell walls are relatively thin, while others possess comparatively thick walls. The cell wall is more usually structureless, although Matthews[1] has observed some cells whose walls exhibited the presence of minute pores, while in other cases he observed a fine interlacing filamentous structure more strongly in evidence at the base of the hair. Thus it would appear that the morphology of a fibre intended for use as a filler should be gone into, as obviously this will have a not inconsiderable bearing on its utility in this direction.

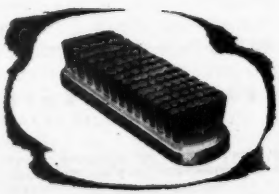
So much, then, for the seed hairs. Now let us deal with the more common commercial fibres, first, with bast fibres, which term really includes fibres derived from more than one portion of the plant structure. Thus, if the fibre is obtained from the phloem portion of the stem, it is obviously a true bast fibre, such materials are typified by such fibres as linen, hemp, jute, etc. On the other hand, when the fibres are obtained from the phloem portion of vascular bundles in the leaf structure, they are not true bast fibres, but should rather be regarded as being sclerenchymous in nature. This distinction is necessary as there are morphological differences, by means of which we are able to identify one from the other. For example, sclerenchymatous fibres are, almost invariably, well supplied with pores in the cell wall; bast fibres seldom, if ever, exhibit this characteristic. Also bast fibres are capable of being identified by the shape of the ends of the fibre element, which point will be discussed in more detail subsequently.

The morphological differences which exist in bast fibres furnish a useful means of identification; thus Matthews (loc. cit.) has divided them into four classes based on the comparative thickness of cell wall and the size of the internal cavity or lumen. For fibres such as ramie and China grass, the lumen occupies about four-fifths of the diameter of the fibre. In the case of fibres typified by pine-apple, sunn hemp, etc., the lumen is about two-thirds of the diameter of the fibre and about one-half the diameter in fibres such as ambari hemp, yucca, New Zealand hemp, etc., while in fibres of the type of linen, the lumen is seen to be a mere line.

In some bast fibres, such as sunn hemp, N.Z. hemp, yucca, pita, linen, ramie, etc., the lumen canal is usually very regular, in consequence of which the cell wall is of uniform thickness, but



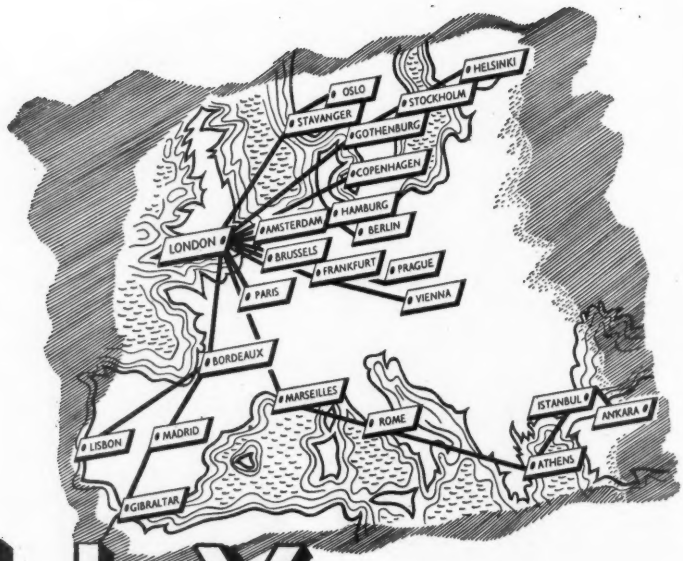
Plastics go to press



Plastics from I.C.I. are in the news. Nylon monofilament print-cleaning brushes have come to stay because they have the greatest staying-power. More and more type is putting its best face forward, thanks to I.C.I. nylon.

ICI

P.246



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in fibres such as jute and coir, the wall thickness is irregular, due to a similar condition existing in the lumen.

One very important characteristic worthy of consideration is the strength of these vegetable fibres. It is well known that both cellulosic and natural fibres are very strong; this would appear to be due, on the one hand, to the inherent strength of the basic material; on the other hand, to the structural characteristics exhibited in the fibre element morphology. In comparing the tensile strength of a few of the common fibres with that of other structural materials, we see, therefore, that they compare very favourably indeed with ferrous materials in general.

Table 1

Material*	Tensile strength p.s.i.
1. (a) Cotton fibre	48,700
(b) Wrought-iron plates with grain	50,000
2. (a) Linen fibre	51,600
(b) Wrought-iron plates with grain	50,000
3. (a) Jute fibre	70,300
(b) Steel, rolled bars	70,000
4. (a) Hemp	110,750
(b) Forged steel (locomotive tyres)	110,000
5. (a) Raw silk	56,700
(b) Soft steel	55,000

* Figures for the fibres—after Matthews.

Table 1 gives the tensile strengths of five commonly used fibres compared with ferrous materials of similar ultimate tensile strength.

From these figures (which are averages for the materials in question) we see that the strength of the cotton fibre may be compared to that of wrought iron when taken in a direction coincident with the grain. The strength of the cotton fibre, however, is slightly less than that for the wrought iron, but the linen fibre gives a strength about 2 per cent. higher than that for the iron, which, of course, shows it to be very strong. This great strength is, however, considerably improved upon by jute at 70,300 p.s.i., which is slightly in excess of rolled steel bars at 70,000 p.s.i. The peak, however, seems to be reached by hemp, with a strength of some 110,750 p.s.i., which is seen to be somewhat greater than forged steel, as used for locomotive tyres, with a strength of 110,000 p.s.i. Raw natural silk, on the other hand, representing the protein fibres, has a strength of about half that of jute at 56,700 p.s.i., and may be compared with soft steel at 55,000 p.s.i.

Thus we may obtain some idea of the enormous strength of the vegetable fibre, but it should be borne in mind that this strength is exhibited by the fibre, with the exception of the unicellular seed hairs

Table 2.—(After Lecomte [2])

Vegetable hairs	Structural fibres (mainly bast)	
	Dicot	Monocot
Cotton Minor hairs— Asclepias Calotropis Epilobium Typha, etc.	*Urticaceæ* Hemp (Cannabis) Ramie (Bœhmeria) Nettle (Urtica) Paper Mulberry (Broussonetia) Hop (Humulus) *Linaceæ* Linen (Linum) *Thymeleaceæ* Lace bark (Lagetta) Nepal paper (Daphne) *Tiliaceæ* Jute (Corchorus) Linden (Tilia) *Malvaceæ* Queensland hemp (Sida) Cæsar weed (Urena) Pseudo hemps (Hibiscus) *Papilionaceæ* Sunn hemp (Crotalaria) Clover (Melilotus) Spanish Sparto (Spartium) *Cordiaceæ* Cordia fibres *Asclepiodaceæ* Giant Asclepias (Calotropis)	*Gramineæ* Sparto grass (Stipa) Weeping sylvan (Lygeum) *Liliaceæ* New Zealand hemp (Phormium Tenax) Yucca (Yucca-sp) Bowstring hemps (Sansevioria : wild sisal) *Amaryllidaceæ* Sisal hemps (agave) *Bromeliaceæ* Pineapple (Ananas) Bromelia fibres (Bromelia) *Musaceæ* Manilla hemp (Musa) *Naiadaceæ* Sea wrack (Zostera) *Palmæ* Coir (Cocos) Raffia (Raphia) Murumuru palm (Astrocaryum) Crin Vegetal (Chamærops) Rattan cane (Calamus) Sago palm (Arenga) Date palm (Phœnix) Talipot palm (Corypha) Oil palm (Elœis)

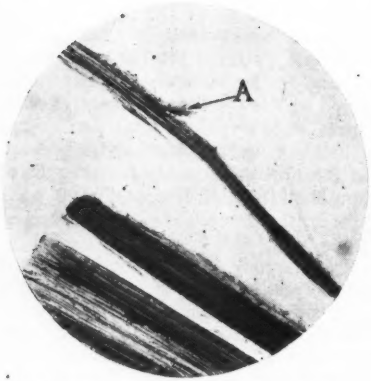

Fig. 174.—American hemp (low grade). Mag. 20 diameters.

Fig. 175.—Jugo Slav hemp. Mag. 20 diameters.

such as cotton, as an entity fabricated from the histological unit or cell, and as such there are several factors which may have an influence. For example, the fibre is composed of a number of parallel rows of cells whose ends fit into one another, the whole being cemented together by the so-called median layer; it is this layer which is dissolved away during the macerating process, so bringing about the disintegration of the fibre into histological elements. It will be clear from this that much of the fibre strength is dependent upon the efficiency of this cement substance, but that in all the cases quoted, the presence of the median layer would appear to effect an increase in the strength of the whole. Thus, referring to Table 1, we find that the strength for cotton is the lowest. This fibre, being a seed hair composed of a single cellulosic cell, may be taken as being representative of the type of element obtained by macerating the larger composite materials, these being the individual tracheids of which the fibre is composed, and as such are comparable to the cotton fibre, and also might be expected to possess similar strength characteristics.

We see, therefore, that there are two ways in which vegetable fibres might be utilized as filling media, the one giving a fine material and consisting of the fibres reduced to their elementary components (by maceration), and the other consisting of the whole fibre, which has been mechanically reduced to give a particle of $\frac{1}{16}$ in. to $\frac{1}{8}$ in. in length, or smaller.

In the first case we have a material which should be fine in texture and reasonably consistent, which, although fundamentally not so strong as the second material, should, nevertheless, be capable of producing somewhat higher strengths in mouldings than fillers of the powder type, evidence of which is to be found in the strength resulting from the use of cotton linters as a filler. At the same time, owing to its fine texture this material may be expected to produce the fine finish so much sought after. In the second case, the material cannot be expected to produce such a fine finish, due to the larger particle size, but it is suggested that in spite of this coarseness the degradation of finish would be so slight as to be almost insignificant; on the other hand, if the fibre is well chosen it would appear possible to attain as much as twice the strength produced by the finer material, due, of course, to the greater strength inherent in the filler particle, and from availability the only problem of any magnitude remaining to be solved is that of reducing fibres, which in some cases might be 4 or 5 ft. in length

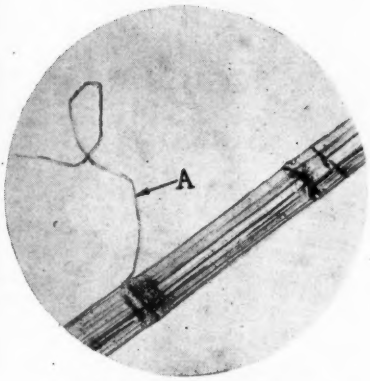

Fig. 176.—Indian hemp.
Mag. 20 diameters.

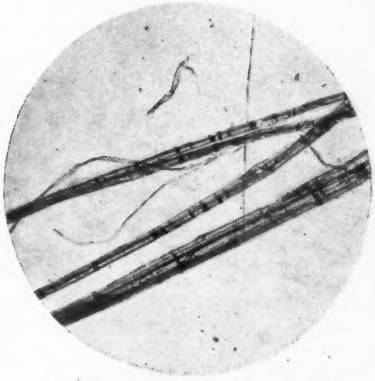

Fig. 177.—Manila hemp (dew retted).
Mag. 20 diameters.

(and sometimes longer), to the short lengths just stated. This does appear to present a certain amount of difficulty, but is by no means insoluble.

Altogether, there are an enormous number of fibres from which to choose, some of them more readily available than others. Table 2 is included in order to convey some idea as to variety. They are arranged according to their botanical classifications, with two or three examples in each class. All the fibres named are used commercially, together with many others, so that the range will be seen to be somewhat extensive; it is, therefore, proposed to subject only a few of them to microscopic examination, with a view to ascertaining their salient characteristics and assessing their value as potential filling materials.

To commence our examination, let us take hemp as being one of the strongest and most widely used fibres. Hemp is a general term applied to a very great number of commercial bast fibres, most of which are obtained from different species of plants. Thus Ambari hemp is obtained from *Hibiscus cannabis*, Bengal hemp comes from *Crotalaria juncea*, and Colorado hemp is got from *Sesabina macrocarpa*. New Zealand hemp, on the other hand, is obtained from *Phormium tenex*, and so on; altogether there must be some hundreds of varieties of plants capable of producing fibres which may be classed as hemp. Therefore it will be obvious that where the demands made upon the fibre call for properties conforming to certain limits, it is not good enough to call it hemp and leave it at that, for one is liable to obtain any one of this array of materials by so doing.

The fibre most usually taken to be hemp, or the so-called common hemp, is obtained from the plant *Cannabis sativa*, which is a dicotyledonous shrub

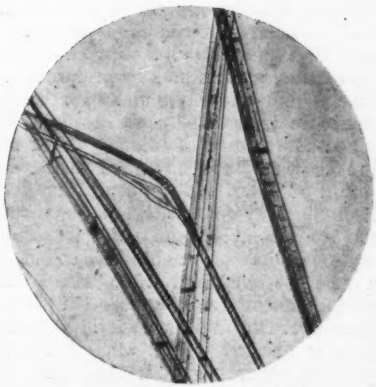

Fig. 178.—Manila hemp fibres.
Mag. 20 diameters.

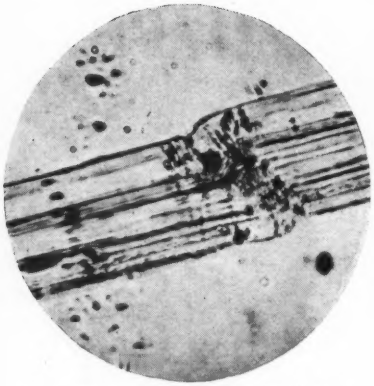

Fig. 179.—Jugo Slav hemp (bruised fibre). Mag. 310 diameters.

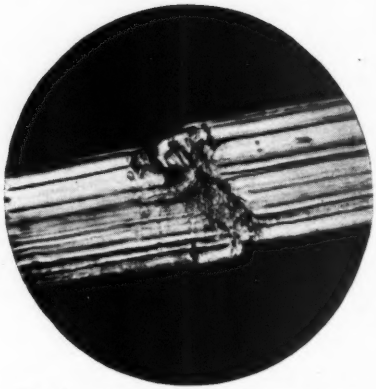

Fig. 180.—Jugo Slav hemp (bruised fibre), under polarized light. Mag. 310 diameters.

growing to any height from 6 to 15 feet. The plant was originally native to India and Persia, but, owing to its value as a fibre producer, it is nowadays extensively cultivated in most tropical and sub-tropical areas of the world. For example, Russia is responsible for the production of vast quantities; likewise a great deal of this material is also produced in America.

The hemp fibre is obtained from the plant by a retting process, which consists in essence of mascerating away the xylem and parenchymous tissue of the vascular bundles, thus leaving the more resistant bast elements in a condition where they may be extracted with comparative ease. The retting process may be performed in several different ways, although two of these are used more generally than the others and consist of bringing about the breakdown of the unwanted matter by means of water. Thus much of the fibre is obtained by dew retting, in which case the fibre containing material is spread out over the surface of the ground in a moist location and left to the mercy of the elements. After a period of two or three weeks the masceration will be found to have reached a point where the fibre may be separated from the wood by mechanical means.

Much the same thing occurs during the so-called "pool" retting, where the plants are allowed to ferment in pools of stagnant water for a number of days, after which the fibre is mechanically separated. The advantage of "pool" retting is that the whole process may be completed in five to ten days, as against two or three weeks for dew retting, also it is generally possible to obtain a very much cleaner fibre by pool retting. The fibre obtained from dew retting is usually grey and somewhat harsh, while that obtained from pool retted material, for example Italian hemp, is of a creamy white colour, lustrous, and pliable in texture. The best hemp fibre is said to be that prepared and extracted by hand from pool-retted material.

A good example of the effect of dew retting is given in Fig. 174, which is a photomicrograph of American hemp produced by this means, at a magnification of 20 diameters. The fibre will be seen to be made up of a large number of small fibrils, which are, in turn, composed of the bast cells cemented end to end. The main point worthy of note is the presence of parenchymatous tissue still adhering to the fibre in places, such as that shown at "A." This tissue would be extremely difficult to eradicate from a powder produced by grinding or cutting this fibre

and as such would function as an impurity in the filler.

Much the same condition is shown by Jugo Slav hemp shown in Fig. 175 at the same magnification. The fibre in both these cases tends to be coarse and possessed of appreciable amounts of extraneous matter. In the case of the Jugo Slav hemp, the separation is not so complete as in the American, as there is evidence of residual spiral vessels and the like, which are not the most suitable components to have in a filler such as that under discussion.

The finer grades of hemp usually obtained by pool retting are much cleaner, as shown by Fig. 176. This is a photomicrograph of a strand of Indian hemp at 20 diameters, from which it is clearly seen to be a clean fibre consisting only of the bast elements. There are certain markings on the strand which will be discussed subsequently, as they form a means of identification. An idea of the size of the elemental fibril will be obtained from the one which has become detached from its fellows, indicated at "A."

Probably the finest hemp is the well-known product of Manila (Figs. 177 and 178). These fibres will be seen to be structurally somewhat finer than the Indian hemp, which is due to their originating from two different species of plant; thus the Indian variety is obtained from *Apocynum cannabium*, which is commonly regarded as true hemp, while the Manila hemp comes from *Musa textilis*, a different plant; however, the characteristic markings are present in the latter, which classes the fibre as a hemp type.

Having examined hemp fibres very briefly from the point of view of their general structure, let us now look at them more closely. In Fig. 179 we see a strand of Jugo Slav hemp which has been cleaned, magnification 310 diameters, exhibiting a structure characteristic of bast fibres. This type of structure is known as a dislocation mark and would appear to be due to a change in direction of the cellulose miscelles, although there is still a considerable amount of speculation as to their method of origin, but Bossuyt and Chandron[3] demonstrated that the displacement could be straightened out by stretching the fibre. However, on the release of the tension the fibre returned back to its normal condition. It is probable that this curious configuration is caused by mechanical forces acting on the growing fibre, but as to what these forces are and their modus operandi, the mystery would appear to be still unsolved. It is, however, possible that this is one of the measures adopted by nature to confer elasticity on the structure, for they would seem to constitute definite points of inherent stress along the length of the fibre requiring an externally applied tension for their neutralization, and as such they would function as an admirable shock absorbing apparatus preventing the rupture of the fibre due to the sudden application of loads above the elastic limit of the basic material. Fig. 180 shows the same fibre at similar magnification, but photographed under polarized light, which demonstrates the strain pattern existing in the fibres at the point of so-called displacement.

(To be continued.)

REFERENCES

(1) *Matthews, "Textile Fibres" (Wiley and Sons).* **(2)** *Lecomte, "Textiles Vegelaux".* **(3)** *Bossuyt and Chandron, "Compt Rendu,"* 1931, 192.

E. K. COLE, LTD., have issued for limited circulation an attractive 44-page brochure centred around their war dispersal. It tells the story of the pre-war Ekco organization at Southend, how the company went over entirely to the production of essential war equipment, shadow factories being organized at Malmesbury, Woking, Aylesbury, and Rutherglen in Scotland. However, one section of the Ekco Works at Southend that did not move was the plastics plant, chiefly for the reason that the heavy presses could not be transported as easily as other factory equipment. By good fortune the plastics plant was able to continue working for 24 hours a day, seven days a week, throughout the whole war period.

Plastics in Tools, Jig and Fixture Constructions

By E. E. HALLS

Vulcanized fibre is the generic term for materials that have been used in the tool room under a variety of descriptions for many years. Hard fibre; grey, black and red fibre; fish paper, bone fibre—these are terms that have been employed. The material is still used on account of its toughness, ease of machining, and immunity from corrosion. It has reasonable resistance to dampness and oil, but does not compare with the newer plastics in these respects.

The following information is based on data given in the National Vulcanized Fibre Handbook, published by the National Vulcanized Fibre Co., of America, supplemented by British Standard Specifications, 216/1936 and 934/1940. It shows the extent to which this material is usable for tools, jigs and fixtures, particularly in the textile industry.

VULCANIZED fibre is a converted cellulose product, available in the form of sheet, rod, tube and section. It is exceedingly tough and shock resisting, but its shortcoming is lack of resistance to water and highly humid atmospheres. In consequence of the latter, it has given place in recent years to the phenolic resin laminated materials for quite a number of applications. Nevertheless, it is still a very useful material.

The Continent, and America in particular, have always been in advance of Britain in the production of the high mechanical strength qualities of this material and in ensuring extreme uniformity of product.

The tough and resilient American grades are almost horn-like in structure, and they are produced by chemical treatment of cotton cellulose. To this end, clean cotton rags are made into a pure cotton cellulose paper, which is then chemically converted into a new structure. The conversion is brought about by soaking in an aqueous solution such as zinc chloride, which effects partial solution, and then leaching out all this chemical, which leaves a homogeneous mass of regenerated cellulose. The treatment can be applied in the paper stage, or to sheets, tubes, etc. The product has to be dried and sheets have to be flattened and calendered to size.

High-grade vulcanized fibre is quite a versatile material. It is light in weight, sp. gr. ranging from 0.90 to 1.30. Strength (tensile, flexural, impact, shear and compression) is high, the material being one of the strongest known per unit of weight. Its toughness enables it to withstand repeated shocks or impact without failure, and its resilience makes it possible for it to recover quickly or "spring back" when subjected to heavy shocks. At the same time, it exhibits resistance to wear and abrasion. Hardness can be varied over a wide range, from soft and leathery to hard and bone-like. The material responds readily to the usual machining processes, and its plasticity enables it to be bent, formed, drawn or swaged into intricate shapes.

Electrically, breakdown strength is quite high under dry conditions, but adversely affected by dampness. However, vulcanized fibre does not readily track or carbonize when subjected to electrical arcing, and any gases evolved are non-inflammable and operate in the direction of extinguishing an arc. Thermal conductivity is low; durability is good, the tendency being to improve with age; dampness may cause swelling or expansion, and heat or dryness promote shrinkage.

With the above-mentioned limitations in mind, vulcanized fibre can usefully be employed in tools, jigs and fixtures. Mechanical and manipulative qualities enable it to be employed for gears, cams, pulleys, cutting boards, gaskets, spools, bobbin heads, shuttle armour, vacuum

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Table 2.—Principal Grades and Uses of Vulcanized Fibre.
(Service : National Vulcanized Fibre Co.)

Grade	Thickness (inches)	Characteristics and applications
Bobbin	⅛ to ½	High gravity, hard stock for bobbin (spool) heads. Excellent machinability, giving glass-smooth finish. High impact strength.
Bone	1/32 to ⅛	Dense hard stock possessing high mechanical strength, resistance to wear. Excellent machining properties. Used for gears, cutting blocks, mechanical applications.
BB Bone	1/16 to ⅛	Extra-hard dense material, wear-resistant and mechanically strong. Harder than "bone fibre." Machines well. High impact strength.
C	0.010 to 2	Semi-hard commercial grade for general use, having unusual combination of properties —good punching and machining quality plus high mechanical and dielectric strengths.
Flexible	1/32 to 1	Obtainable in various degrees of flexibility. Used for valve-seat washers, etc., for tight seal. Has high resistance to abrasion.
Guard	0.060 to 0.090	Used in sports goods and industrial safety appliances, such as shields, shoulder pads, shin guards, etc. High impact strength and excellent forming quality.
P	0.030 to ½	Good punching and bending quality with high dielectric strength. Similar in quality to Peerless Insulation.
Peerless Insulation	0.004 to ⅛	Special high-grade fibre having best punching and forming properties—high dielectric, mechanical and bending strengths. This is the original "fish paper."
R	0.005 and 0.010	Used by rubber industry as top lifts for rubber heels, soles, etc., by vulcanizing to the rubber. Unusual bending strength. Supplied with uncalendered surfaces.
S	0.010 to 0.040	Exceptionally tough stock for backing abrasive discs. Good wearing properties as well as high tear and tensile strengths.
Shoe	0.035	Special stock for heel seats and arches. Exceptionally tough and strong. Prevents nails or rivets from pulling out.
Shuttle	3/32	Used in textile industry as armour for shuttles. Tough, non-splintering stock having excellent wearing and suitable glueing qualities. Will polish to glass-smooth finish.
Special White	0.005 to ⅛	Clean white material with good working qualities and high mechanical strength. Used primarily where clean white appearance is essential.
Tag	0.010–0.012 –0.015	Tough, clean white stock for laundry tags, etc., with smooth surfaces for printing. Special treatment prevents "feathering" of ink. Resistant to dry-cleaning fluids, oil, etc.
Trunk	0.018 to ⅛	Used for trunks, suitcases, etc., where tough, resilient material is required. Good bending and punching quality. Satisfactory surface for varnishing. Obtainable in embossed grained surfaces.

cleaner tools, welders' shields, handles of various types, abrasive disc backing, and all types of boxes and receptacles. Its electrical properties, in conjunction with its manipulability, render it suitable for terminal and switch insulation, arc shields, coil forms, bushings and the like.

The National Vulcanized Fibre Co.'s sheet covers thickness ranging from 0.004 to 2 ins. Sheet sizes are up to 48 ins. by 80 ins. Material up to 0.090 in. can be provided in rolls, width 48 ins. Standard shades of colour are red, grey and black, but special colours are available in some grades. Coefficients of friction and expansion are given in Table 1.

Table 1.—Characteristics of Vulcanized Fibre.

Coefficient of friction :	
Fibre on fibre	.. 0.21
Fibre on smooth cast iron ..	.. 0.16
Coefficient of linear expansion :	
Per deg. Fahr.	.. 0.000015
Per deg. Cent. ..	.. 0.000027

The material can be regarded as having a density of 20 cubic ins. per lb. for estimating purposes. The principal available grades and their uses are listed in Table 2.

The grade known as "Bobbin" fibre is used in the textile industry which requires a tough, light, non-splintering material for its bobbin heads, and surfaces and edges that can be machined

and polished to a glass-smooth finish in order to attain highest production speeds and maximum quality of yarn.

"Bone" grade is characterized by highest density, resistance to wear and resistance to abrasion, as well as toughness, and is developed for noiseless gears, cams, cutting blocks, thrust washers and other purposes where maximum punishment has to be endured.

"Flexible" grade has been developed by giving a special glycerine treatment, and this material is suitable for jobs such as gaskets, and bib and faucet washers.

"Guard" fibre is a grade developed for personnel guards, for example, for protective caps and helmets for mine workers and labourers in other hazardous industries. It is intended to resist shock without denting.

"Shoe" fibre, as its name suggests, is developed as a heel seating reinforcement, but it has other obvious possibilities. The shoe industry itself uses grades of fibre as patterns and last top protectors.

"Shuttle" fibre is the material developed for the textile industry for completely cladding the wooden shuttle, being firmly secured by means of glue or cement. It is polished to a glass-smooth finish to prevent "catching" of the yarn or thread. It is non-splinterable, non-corrosive and requires no lubrication, and the material stands up to the slamming to and fro in the loom at extremely high speeds very well indeed, giving long and uninterrupted service.

"Trunk" fibre is usually used in thicknesses from 0.018 to $\frac{1}{8}$ in. for gluing as a veneer to both surfaces of the wood for cases and containers. Fibre or metal angle and corner pieces can be used and fixed by riveting. Such material stands very hard wear with heavy loads, resisting bursting stresses as well as battering and chafing. Scratches tend to "self-heal." Other containers in all sizes and shapes are made from vulcanized fibre with reinforced edges and riveted seams and forms.

"R" grade fibre is specially developed for vulcanizing directly to rubber in the moulding operation. It withstands the vulcanizing operation and retains its own toughness. The material has to have the right surface texture for enabling the rubber to adhere, and the correct porosity for the diffusion of vulcanizing gases. It is specially developed for bonding to one surface of rubber heels to give a "restricting" effect to the heel, preventing the rubber from spreading outwards under the weight imposed during wear. Extended applications are likely.

"Peerless" is the special electrical grade of fibre used for slot insulation, arc shields, etc.

Grade "S" fibre is a flexible grade for abrasive discs for sanding and grinding operations. It has to be tough and to exhibit high tear resistance and possess good gluing properties to hold to grit.

Tubing is made in a manner similar to that employed for the sheet. The cotton base paper is gelatinized by means of a chemical solution and then wound on steel mandrels to give the desired internal diameter and wall thickness. The tube is then leached free from chemicals and dried, rolled and ground. The density is inherently a little higher than that of sheet, and the material has excellent properties for machining, and it may be turned, threaded, bored and swaged without difficulty. Length is 2 ft. for inside

Table 3.—Wall Thickness of Tubes

Inside diameter (inches)	Minimum wall (inch)	Maximum wall (inch)
$\frac{1}{4}$ to $\frac{7}{32}$	0.020	$\frac{1}{8}$
$\frac{1}{4}$	0.020	$\frac{1}{8}$
$\frac{9}{32}$ to $\frac{11}{16}$	$\frac{1}{32}$	$\frac{1}{8}$
$\frac{3}{4}$ to $1\frac{1}{2}$	$\frac{1}{32}$	$\frac{5}{32}$
$1\frac{3}{4}$	$\frac{1}{16}$	$\frac{5}{32}$
$1\frac{1}{2}$	$\frac{1}{16}$	$\frac{3}{16}$
4 and over	$\frac{1}{8}$	$\frac{3}{16}$

Table 4.—Tolerances on Outside and Inside Diameter of Tubes

Nominal outside diameter (inches)	Tolerances on outside or inside diameter, plus or minus (inch)
Up to $\frac{1}{2}$ incl.	0.004
$\frac{17}{64}$ to 1 incl.	0.005
$1\frac{1}{16}$ to 2 incl.	0.008
$2\frac{1}{16}$ and over	0.010

diameters up to $\frac{3}{8}$ ins., and 3 ft. for greater diameters. Wall thickness of tubes and tolerances on inside and outside diameters are given in Tables 3 and 4.

Rods are made from sheet material by cutting into square bars and then turning and grinding to accurate diameters from 3/32 to 2 ins. Lengths up to 6 ft. are obtainable. Machining on lathes or in automatic screw machines can give a very fine finish. Drilling, threading and tapping is simple, and the accuracy supplied on outside diameter is generally good enough to eliminate any need to turn to size.

Regarding the manipulability of vulcanized fibre in machining operations, the National Vulcanized Fibre Co. state that a certain amount of flow can be induced in the material, particles being forced to move their position in relation to others and then to "freeze" in the new positions. A punch press or hydraulic press can be used for forming. For simple shapes requiring little moisture, a punch press is used and the operation may be completed in a fraction of a second. In more complex or larger jobs, the fibre has to be moistened and formed on a hydraulic press, and the forming and drying may occupy several minutes.

BENDING.—Simple bends can be made in an angle brake while the fibre is moist; it is then held to shape in a suitable fixture while it dries and hardens. A shape with a number of bends can be moistened by steam to assist its flow and formed in a hydraulic press under high temperature. It is then placed in a fixture to cool.

U-SECTION FORMING.—Round, oval, square or rectangular shapes, symmetrical or otherwise, can be punch pressed with a U-section.

DRAWING.—Flat sheet is moistened and drawn to deep shapes in hydraulic presses and finally dried in heated dies.

SWAGING.—Vulcanized fibre can be swaged on a punch press, flowing into the hollows of the die to form the specified shape. The height of the raised portion is limited.

CUPPING.—Sheet material is slightly moistened to aid flow and brought to shape in a punch press with a single flow. With deep cupping, the form has to be placed on a fixture to harden. The greater the diameter the deeper the cup that can be formed.

FLARING.—Tube is flared by spinning on a screw machine or lathe, using a stationary tool pressed outwards, thus expanding the diameter. The "belling" effect is due to flow which is greatly assisted by the frictional heat of the operation.

SPINNING.—Screw machines can be used for spinning inwardly, heat of friction between the tubing and stationary tool aiding the fibre in proper flow.

CIRCULAR SAWING (where smooth edges and close tolerances are required).

Saws—Carbon steel, tempered to permit sharpening by grinding.

Set—None, hollow ground for clearance.

Teeth—Six per inch for $\frac{1}{16}$-in. stock; four per inch for $\frac{1}{8}$-in. and over; eight per inch for tubing.

Saw thickness—$\frac{1}{16}$ in. for $\frac{1}{16}$-in. stock; 3/32 in. for $\frac{1}{8}$-in. stock; $\frac{1}{8}$ in. for $\frac{1}{4}$-in. stock and over.

Saw diameter—12-in. dia. for $\frac{1}{16}$-in. stock; 14-in. dia. for $\frac{1}{8}$-in. stock and over; 16-in. dia. for tubing.

Feed—Feed work into saw, but do not force.

Speed—2,700 to 3,600 r.p.m.

Sharpening—Sharp point, little front rake. Grind square on cutting edge. Dull saws cause chipping, excessive heating. After sharpening, remove burr on side of saw with abrasive block.

Tube should be slowly revolved while sawing for better edge and less heating.

BAND SAWING (where smooth edges and close tolerances are not required).

Saws—Tempered steel to permit sharpening by filing.

Set—Staggered teeth used to give clearance and eliminate heating. Medium set for straight cuts; heavy set for circular cuts; smaller the circle, heavier the set for clearance.

Teeth—Three points per inch for material over 3 ins. thick; five points per inch for straight cuts and discs over 6 ins. dia.; six points per inch for

Table 5.—Nema Specification Values for Vulcanized Fibre.

Minimum Tensile Strength (lb. per sq. in.)

Thickness (inch)	Bone grade		Mechanical and electrical grade	
	Crosswise	Lengthwise	Crosswise	Lengthwise
Up to $\frac{1}{8}$ incl.	6,500	8,500	6,000	8,000
$\frac{1}{8}$ to $\frac{1}{4}$	6,000	8,000	5,500	7,500
Over $\frac{1}{4}$	—	—	5,000	7,000

Minimum Compressive Strength (lb. per sq. in.)

	Bone grade	Mechanical and electrical grade
All thicknesses	30,000	20,000

Minimum Flexural Strength Mechanical and Electrical Grade (lb. per sq. in.)

	Crosswise	Lengthwise
Load applied on $\frac{1}{4}$ in. thick and over	Face or edge 11,000	Face or edge 13,000

Minimum Dielectric Strength for Electrical Insulation Fibre

Thickness (inch)	Volts per mil.
0.004 to 0.005 incl.	200
Over 0.005 to 0.015 incl.	300
Over 0.015 to 0.040 incl.	250
Over 0.040 to $\frac{1}{4}$	175

scroll work and discs under 6 ins. dia.
Saw thickness—No. 20 gauge (0.037 in.).
Guides—Keep as low as possible.
Width—1 in. to $1\frac{1}{2}$ ins. wide for straight cuts; $\frac{1}{2}$ in. wide for discs over 2 ins. dia.; $\frac{1}{4}$ in. to $\frac{3}{8}$ in. wide for scrolls and discs under 2 ins. dia.
Sharpening—Keep sharp for best results, file straight across tooth in automatic sharpeners.
Speed—4,000 to 5,000 lineal ft. per min.
Feed—At rate for free-cutting, but do not force.

MILLING.

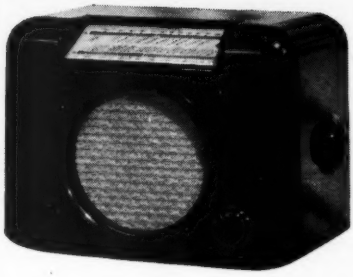
Tools—High-speed or carboloy-tipped tools for large quantities. Cutters should be kept sharp; dull cutters cause heat.
Grinding—Cutting angle at slight rake (3 degrees to 5 degrees more rake than for metal).
Speed—Same as for brass, 25 per cent. higher than most metals.
Feed—Same as for brass—full cut best, if possible.

SHEARING.

Shears—Power-operated metal squaring shears—straight knife, $1\frac{1}{2}$ degrees rake.
Method—Heating fibre slightly will give cleaner edges. Fibre up to $\frac{1}{4}$-in. thickness may be sheared with good results.

DRILLING.

Type Drill—High-speed "Bakelite" drill best—has steeper twist, narrow web, highly polished flutes—gives more clearance for chip.
Back Up—Work should be backed up with hard material for clean edges free from burrs.
Grinding—Grind slightly off centre, otherwise hole will be 0.001 to 0.003 in. undersize. Off-centre grinding lessens heating. Grind to 94 degrees point. Remove rake by grinding lips parallel to drill axis (prevents digging).
Speed—Highest speed without burning; slow for larger diameters. $\frac{1}{4}$-in. dia., 3,000 r.p.m.; 1/32-in. dia., 10,000 r.p.m. not too great.
Feed—Do not force drill, especially parallel to laminations. Back out



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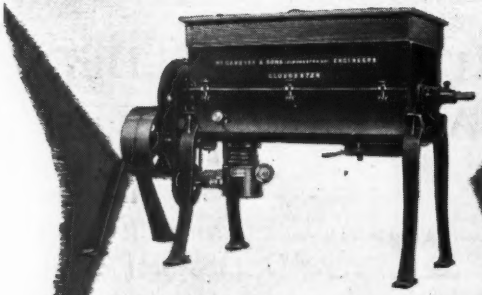

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Table 5 (continued)

Maximum Water Absorption

Thickness (inch)	Change in weight (per cent.) Bone grade		Mechanical and electrical grade	
	2 hrs.	24 hrs.	2 hrs.	24 hrs.
1/32 to 1/8	50	60	55	65
Over 1/8 to 1/4	20	50	25	60
Over 1/4 to 1	10	25	15	35
Over 1	5	15	8	20

Minimum Density of Electrical Insulation and Mechanical and Electrical Grade Fibre

Thickness (inch)	Density
Under 0.010	0.90
0.010 to 3/32 incl.	1.15
Over 3/32 to 1/4 incl.	1.20
Over 1/4 to 1 incl.	1.10
Over 1 to 1 1/4 incl.	1.05
Over 1 1/4	1.01

Note.—Density equals specific gravity when specific gravity is based on water at 4°C.

Minimum Density of Bone Grade

Thickness (inch)	Density
1/32 to 1/4	1.3

Note.—Density equals specific gravity when specific gravity is based on water at 4°C.

Minimum Dielectric Strength for Mechanical and Electrical Fibre

All grades (inch)	Volts per mil.
Up to 1/16 incl.	175
Over 1/16 to 1/8 incl.	150
Over 1/8 to 1/4 incl.	100
Over 1/4 to 1/2 incl.	50
Over 1/2 total, at least	25,000 volts

frequently to cool and to clean away chips.

Lubricant—Not necessary, but helps for large-diameter holes.

TAPPING.

Tap—Same as for metal.

Tap drill—Slightly larger than for metal (0.003 to 0.006 in. larger).

Lubricant—Slight application of light machine oil gives chips more freedom.

Large holes—Collapsible taps are best for holes over 1½-in. dia.

THREADING.

Tools—High-speed steel ground as for brass, slight negative rake. Sharp chasers essential for strong, clean-cut threads.

Method—Chasing on engine lathe, best results especially for fine threads.

Self-opening die, better for quantity production.

Speed—Same as for brass.

Feed—Same as for brass, not over 0.007 in. per cut, 0.003 in. cut to finish. Remove burr on tops of threads with file between cuts.

Fine threads—Chase in engine lathe with single V-point tool.

PUNCHING.

Dies—Compound—most satisfactory die for intricate pieces. Progressive—best for high-speed fabrication.

Speed—Up to 150 strokes per minute on punch press.

Temperature—for hot punching, heat stock to approx. 250 degrees F.

Design—Minimum clearance between punch and die. Stripper plate should

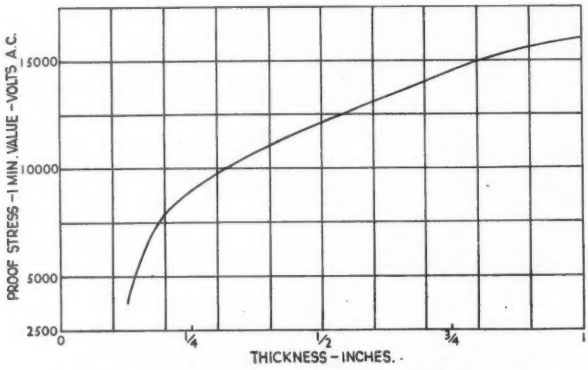

Fig. 1.—Electric strength of vulcanized fibre, B.S.S. 216/1936.

be under compression and fit punches closely.

Dimensions—Punches must be made oversize for hot punching because material shrinks in cooling. Allowance depends upon thickness, temperature and size of hole. For $\frac{1}{8}$-in. hole in $\frac{1}{16}$-in. stock, make punch 0.003 to 0.005 in. oversize. For $\frac{1}{8}$-in. hole in $\frac{1}{8}$-in. stock, make punch 0.012 to 0.015 in. oversize.

SHAVING.

Dies—Hollow dies of desired shape—tool steel, hardened.

Method—Brass or soft steel plate on ram of punch press forces material through die. Should shave off $\frac{1}{16}$ to $\frac{1}{8}$ in. material per shave.

Stock—Fibre up to $\frac{3}{16}$ in. shave cold; fibre $\frac{3}{16}$ to 2 ins., shave hot. Heat to 200 degrees to 250 degrees F., and wipe with hot oil.

Cutting edge—45 degrees bevel, not too sharp; best results if a trifle dull.

TURNING, BORING, ETC.

Tools—Round nose; high-speed steel, or carboloy-tipped for quantity production.

Feed—Same as for brass. Take cut as coarse as possible ($\frac{1}{16}$ to $\frac{1}{8}$ in.); finishing cut, 0.010 in.

Speed—Same as for brass (about 25 per cent. faster than other metals). Peripheral speed 400 ft. per minute for high-speed steel and 700 ft. per minute for carboloy-tipped tools.

Clearance—30 degrees to 60 degrees, no rake.

Table 6 shows the weight per area relationship between vulcanized fibre and the common metals of engineering. The specific properties of their grades conform to those of the Nema standards for commercial and bone materials, as given in Table 5.

Vulcanized fibre is covered by two British Standard Specifications, B.S.S. 216/1936 for natural colour sheets and B.S.S. 934/1940 for natural colour rods

Table 6.—Weight Comparison of Vulcanized Fibre with Metals.

Material	Number of pieces (same size and thickness) per lb.
*Diamond vulcanized fibre ..	1,002
*Aluminium	517
Duralumin	495
Steel	176
Bronze	145
Brass	134

* Diamond fibre weighs about half as much as aluminium.

Table 7.—Tolerance on Thickness of Vulcanized Fibre Sheets.—B.S.S. 216/1936

Nominal thickness (inch)	Tolerance (mils.) plus
$\frac{1}{16}$	9
Above $\frac{1}{16}$ to $\frac{1}{4}$ incl.	12
Above $\frac{1}{4}$ to $\frac{1}{2}$ incl.	15
Above $\frac{1}{2}$ to $\frac{3}{4}$ incl.	18
Above $\frac{3}{4}$ to $1\frac{1}{4}$ incl.	22
Above $1\frac{1}{4}$ to $2\frac{1}{2}$ incl.	30
Above $2\frac{1}{2}$ to 1 incl.	35

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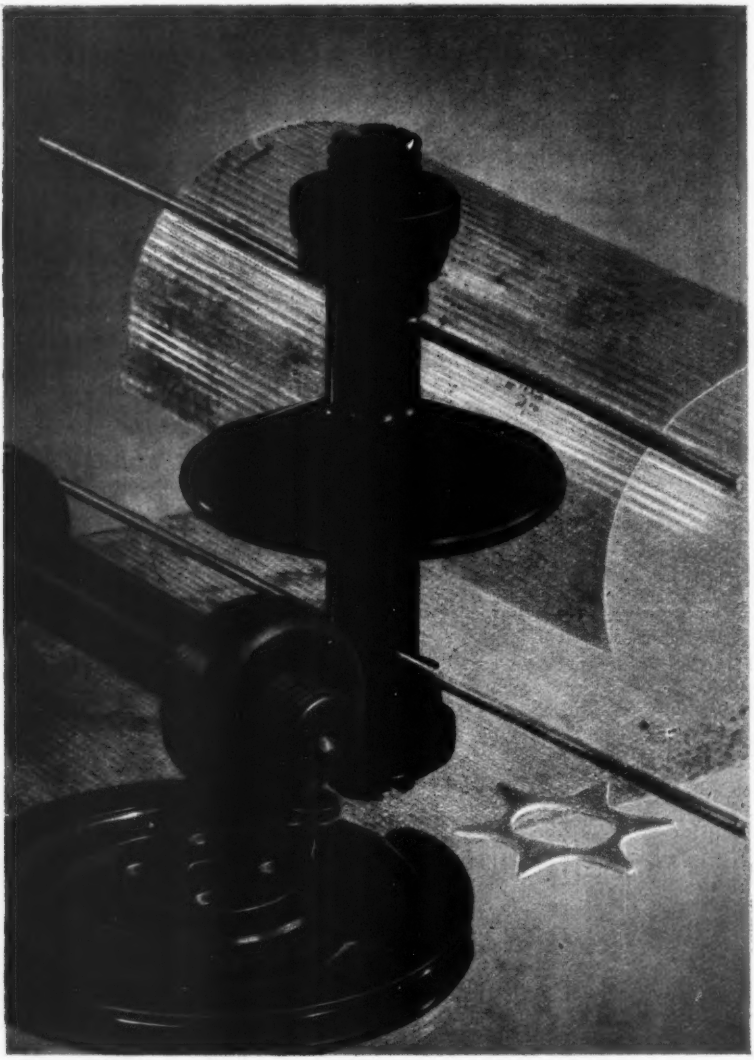

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Table 8.—Moisture Loss and Shrinkage of Sheets in Air.—B.S.S. 216/1936.

	Max. moisture loss (per cent.)	Max. shrinkage (per cent.)		
		Longitudinal	Transverse	Perpendicular
All thicknesses	8	2	3	6

Table 9.—Shrinkage of Vulcanized Fibre Sheets in Oil.—B.S.S. 216/1936.

	Max. shrinkage in oil (per cent.)		
	Longitudinal	Transverse	Perpendicular
All thicknesses	1	1½	3

and tubes, both in use for electrical purposes. These specifications show the nature of the standard grades of material which are available.

B.S.S. 216/1936 covers vulcanized fibre sheet thicknesses from $\frac{1}{16}$ to 1 in., and it describes the material required as consisting of superimposed layers of specially prepared paper, chemically treated so that the laminæ are virtually destroyed with the production of a homogeneous mass of converted cellulose. The sheets have to be finished with a uniformly matt surface and must be free from twisting, splitting along edges, excessive warping and internal fractures. Sheets have to be trimmed with square edges.

Regarding limits on thickness, these are closer than the American tolerances, because they are unilateral. Thickness must not be below the nominal specified value, and the plus tolerances are given in Table 7. Further, the variation in any one sheet must not be greater than half of the allowable tolerance.

Requirements are included for moisture loss and shrinkage in air and in oil. Dimensional changes on test pieces 1½ ins. square are determined by measuring before and after conditioning at 15 to 25 degrees C. and 75 per cent. humidity for 18 hours, minimum. Moisture loss is determined on the same sized specimen by subjecting to 48 hours at 105 degrees C. ± 2 degrees C. Shrinkage

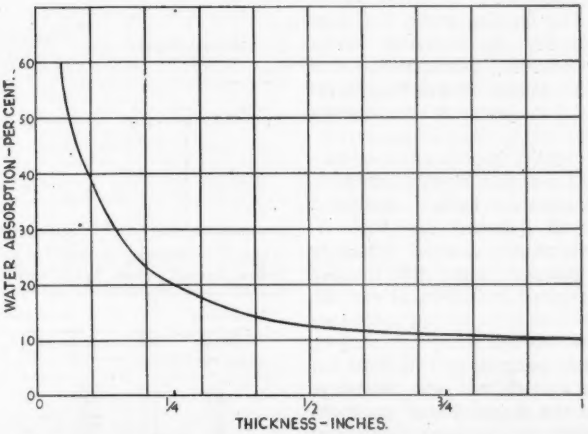


Fig. 2.—Water absorption of vulcanized fibre sheet, B.S.S.216/1936.

Table 10.—Density of Vulcanized Fibre Sheets. —B.S.S. 216/1936

Limits of thickness (inch)	Min. density (gram/c.c.)
1/16	1.20
Above 1/16 to 1/8 incl.	1.30
Above 1/8 to 1/4 incl.	1.25
Above 1/4 to 1/2 incl.	1.20
Above 1/2 to 3/4 incl.	1.15
Above 3/4 to 1 incl.	1.10

Table 11.—Tensile Strength of Vulcanized Fibre.—B.S.S. 216/1936

Nominal thickness (inch)	Minimum tensile strength (lb./sq. in.)	
	Longitudinal	Transverse
1/16	11,000	7,000
Above 1/16 to 1/8 incl. ..	10,000	6,500
Above 1/8 to 1/4 incl. ..	9,000	6,000

Table 12.—Shearing Strength of Vulcanized Fibre.—B.S.S. 216/1936

Nominal thickness (inch)	Minimum shearing strength (lb./sq. in.)	
	Longitudinal	Transverse
1/16 to 1/8 incl.	14,000	12,000
Above 1/8 to 1/4 incl. ..	11,000	9,000
Above 1/4 to 1/2 incl. ..	9,000	8,000

in oil is likewise recorded on specimens 1½ ins. square when heated in transformer oil at 105 degrees C. ± 2 degrees C. for 48 hours. The limiting values for these characteristics are reproduced in Tables 8 and 9. Density, determined on a sample 1½ ins. square by weighing in air and in petrol is subject to the limits given in Table 10.

Electrical quality is covered by a one-minute proof test for electric strength, the requirements being expressed graphically as shown in Fig. 1. Mechanical quality is covered by tensile and shear strength tests, the limiting values being given in Tables 11 and 12.

Flexibility and cohesion between layers, as well as ageing, are covered by wrapping tests using strips 1 in. wide cut in both the longitudinal and transverse directions of the sheet. These specimens are subjected to a heat cycle at 105 degrees C. ± 2 degrees C. for 48 hours, followed by cooling off for at least 18 hours in an atmosphere of 75 per cent. humidity (± 5 per cent.) at 20 degrees C. ± 5 degrees C. Each specimen is then bent slowly round a mandrel through 90 degrees. The size of mandrel must be as shown in Table 13, and no sign of cracking, or splitting along the laminæ, must be evident.

A bend test on specimens 1 in. wide from each direction is also applied after the heat test, followed by the conditioning. This bend test is applied with the specimen, plane horizontal, supported on two rods of ⅜ in. diameter, the centres of the rods being spaced apart at distances as shown in Table 14 for the various thicknesses of sheet. The load is applied through a ⅜ in. diameter rod

Table 13.—Wrapping Tests on Vulcanized Fibre Sheets After Ageing. Mandrel Diameters for Test to B.S.S. 216/1936

Nominal thickness (inch)	Diameter of mandrel (inches)	
	Longitudinal test	Transverse test
1/16	½	½
3/32	1½	2½
⅛	2½	3

Table 14.—Spacing Between Support Rods for Bend Test on Vulcanized Fibre Sheet to B.S.S. 216/1936

Nominal thickness (inch)	Spacing between centres of rods (inches)
3/16	4½
¼	5
⅜	6
½	7
⅝	8
¾	8½
⅞	9½
1	10

Table 15.—Bending (Proof) Tests on Vulcanized Fibre Sheets after Ageing.—B.S.S. 216/1936

Nominal thickness (inch)	Proof load (lb.)	
	Longitudinal	Transverse
3/16	100	80
¼	130	100
½	400	300
¾	750	600
1	1,000	800

centrally spaced between the supports. The load is increased at a steady rate of from 350 to 450 lb. per min. until the load given in Table 15 is reached. This load is maintained for 1 min. The effect upon the specimen is noted and the deflection at the centre of the span with the load on is measured at the end of the minute. No failure shall occur and the deflection shall be 0.25 in. per min.

Water absorption on 1½ ins. square specimen, conditioned for 18 hours minimum at 15-25 degrees C., and 65 to 75 per cent. humidity, is determined by immersion in distilled water for 24 hours at 20 degrees C. ± 2 degrees C. The water absorption must not exceed the value given in the curve in Fig. 2.

The total chlorides, expressed as chlorine, must not exceed 0.01 per cent. when determined on a water extract.

Machining tests are also covered by shaping, turning, milling and drilling. Punching is included for sheets up to and including ¼ in. in thickness. Tapping and slotting are also embraced. These tests are carried out and the test piece then examined for cracking, splitting, chipping and raggedness.

B.S.S. 934/1940 covers natural colour rods and tubes, circular rods ranging from ¼ to 1 in. diameter and circular tubes from ¼ to 2 ins. internal diameter, with a wall thickness from 1/32 up to ¼ in. The rods and tubes have to be uniformly and smoothly finished, and free from twisting, splitting, or excessive warping. The ends have to be trimmed at right angles to the length. The limits on dimensions of rods are given in Table 16. The minimum density is given in Table 17.

Table 16.—Tolerance on Diameter of Rods.—B.S.S. 934/1940

Diameter (inch)	Tolerance (mils)
¼	±5
Above ¼ up to 1	±6

Table 17.—Density of Rods.—B.S.S. 934/1940

Diameter (inch)	Min. permissible density (grams/c.c.)
¼	1.25
Above ¼ up to and incl. ½ ..	1.20
Above ½ up to and incl. ¾ ..	1.15
Above ¾ up to and incl. 1 ..	1.10

Table 18.—Tensile Strength of Rods.—B.S.S. 934/1940

Diameter (inch)	Min. tensile strength (lb./sq. in.)
Up to and incl. ¼	10,000
Above ¼ up to and incl. 1 ..	9,000

Table 19.—Water Absorption of Rods.—B.S.S. 934/1940

Diameter (inch)	Max. permissible water absorption (per cent)
¼	35
Above ¼ up to and incl. ½ ..	30
Above ½ up to and incl. ¾ ..	20
Above ¾ up to and incl. 1 ..	15

Shrinkage in air is covered by a test on a specimen 1½ ins. long, first conditioned in an atmosphere of 75 per cent. humidity, ± 5 per cent., at a temperature of 15-25 degrees C. for 18 hours minimum. The length and diameter of the specimen are recorded and the sample is then heated for 48 hours at 105 degrees C., ± 2 degrees C., in a well-ventilated oven. The specimen is then removed and allowed to cool to atmospheric temperature, when the dimensions are immediately rechecked. The maximum shrinkage for rods allowable is 2 per cent. on length and 4 per cent. on diameter.

The limits for tensile strength are shown in Table 18.

Water absorption is determined on a specimen 1½ ins. long, conditioned before test. The immersion time in distilled water is 24 hours at 20 degrees C. ± 2 degrees C. The limiting values for water absorption are shown in Table 19.

Moisture content is determined by a moisture loss test on specimens 1½ ins. long in the condition as received. The treatment to which subjected comprises 48 hours at 105 degrees C. ± 2 degrees C.

Table 20.—Tolerance on Diameter of Tubes.—B.S.S. 934/1940

Internal diameter (inch)	Tolerance on int. and ext. diam. (mils.)
¼	± 5
Above ¼ up to and incl. ½ ..	± 6
Above ½ up to and incl. 1 ..	± 8
Above 1 up to and incl. 2 ..	±10

Table 21.—Shrinkage of Tubes in Air.—B.S.S. 934/1940

Wall thickness (inch)	Shrinkage (per cent.)		
	Length	Int. diam.	Ext. diam.
From 1/32 to ¼ ..	2.5	1.5	2.5

Table 22.—Electric Strength (Proof Stress) of Tubes in Air.—B.S.S. 934/1940

Wall thickness (inch)	Proof stress (volts)
1/32	2,000
1/16	3,000
⅛ and above	5,000

in a well-ventilated oven. The specimen is reweighed immediately after cooling to atmospheric temperature. The maximum allowable moisture loss is 8 per cent. Rods have to pass machining tests similar to those designed for sheet material without showing any signs of splitting, cracking, chipping or raggedness.

Chlorides expressed as chlorine and determined by an extraction test must not exceed 0.1 per cent.

Regarding tubes, dimensional tolerances are shown in Table 20, and additionally, in any one tube the external diameter at any point must not differ from the mean external diameter by more than ± 2½ per cent.

Table 23.—Water Absorption of Tubes.—B.S.S. 934/1940

Nominal wall thickness (inch)	Max. permissible water absorption (per cent.)
1/32	55
1/16	50
⅛	40
¼	20

Density must not be less than 1.35 grams/c.c. Shrinkage carried out on 1½-in. specimens in the same way as for rods is limited to the values given in Table 21.

Electrical properties are covered by a proof test for electric strength in air and the values given in Table 22 must be withstood for 1 minute without failure and without any signs of steaming or smoking. A surface breakdown proof test is also included, i.e. 10,000 volts for 1 min. without spark-over and without steaming or smoking.

Tensile strength is limited to a minimum of 8,000 lb./sq. in. of cross-sectional area of the wall. Water absorption is covered by the limits given in Table 23, and moisture loss, determined in the same way as for the rods, to 8 per cent. maximum. Machining tests are covered as with rods and sheets. Water soluble chlorides expressed as chlorine are permitted to the extent of 0.05 per cent. maximum.

Plastics Industry Golfing Society

The Institute of the Plastics Industry Golfing Society held a meeting at Sandy Lodge Golf Club, Northwood, Middlesex, on Thursday, April 24.

The "Higgins" Trophy and "F. A. Hughes" Trophy were competed for in the morning (medal round) and afternoon (Stapleford bogey) respectively. The winner of the medal round for the "Higgins" Trophy was Mr. G. L. Barron, playing off a handicap of 21, who returned a net score of 79. The runners-up were Mr. R. G. D. Riddell, handicap + 1, and Mr. R. F. Johnson, handicap 6, who both returned a net score of 81. The "F. A. Hughes" Trophy was won by Mr. R. G. D. Riddell with 27 points and the runner-up was Mr. R. F. Johnson with 25 points.

The best visitor's score in the morning and afternoon was returned by Mr. H. E. Crouch, handicap 16, with a net score of 84 in the morning and 26 points in the afternoon.

Leaves from a Moulder's Notebook

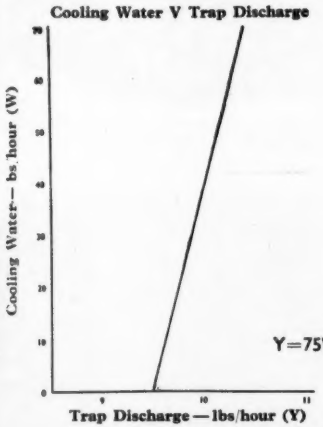
This is the sixth in a series of notes by the B.I.P. Development Department on the problems of the moulder and designer. B.I.P. will send a copy of previous notes on request and will welcome comments and enquiries.

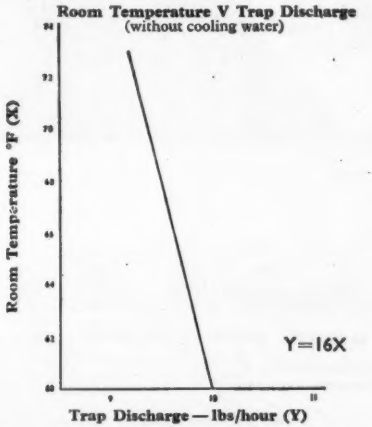
Insulating by Water Flow

The heat reaching a compression moulding press by conduction from the platen or mould through insulation (rendered inefficient by virtue of its pressure resistant qualities) makes its presence felt in a number of ways before performing inconsistently — and yet too well in the summer — the only useful task it carries out, that of increasing atmospheric temperature. It causes expansion of press members, shortens the life of ram packings besides making a press an uncomfortably hot object to lean against. The fastening of gauges and temperature controlling devices is also affected by this heat.

An efficient insulation medium, if by efficient is meant the ability to protect the press members from an undue rise in temperature without wasting heat, has not been discovered, but water if used in a controllable manner can prevent heat reaching the press to an unwonted degree. The difficulty lies in using the heat absorbed by the water.

The B.I.P. Development Department has carried out investigations regarding (a) the use of water as an insulation, and (b) use of the heat absorbed by the water. B.I.P. are publishing a monograph ("*The Economical Use of Cooling Water for Heat Insulation of Presses and subsequently for Space Heating*") which describes, among other things, to what degree and at what cost the atmosphere and the press members become overheated with normal insulation, and particularly the great effect on steam consumption of a change in atmospheric temperature.





Examples are given in the graphs above, from which it will be seen that a drop in room temperature of 5°F. costs more in steam fed to a press than the use of 24 lbs. of "insulating" water per hour. This amount of water is sufficient to keep the press temperature below 100°F., and ensures long life to packings with no untoward distortion of press members.

The monograph will be printed shortly, and copies will gladly be sent on request to:—

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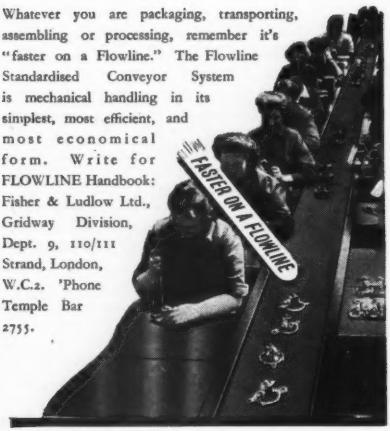

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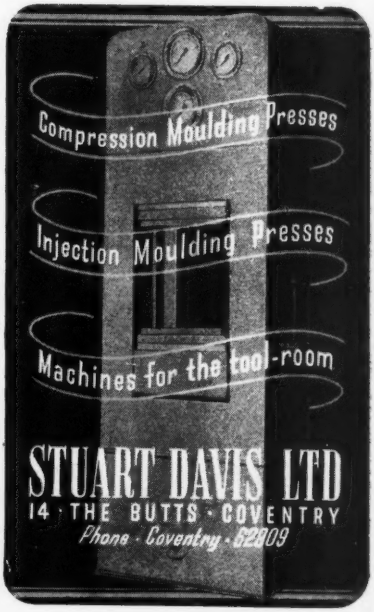

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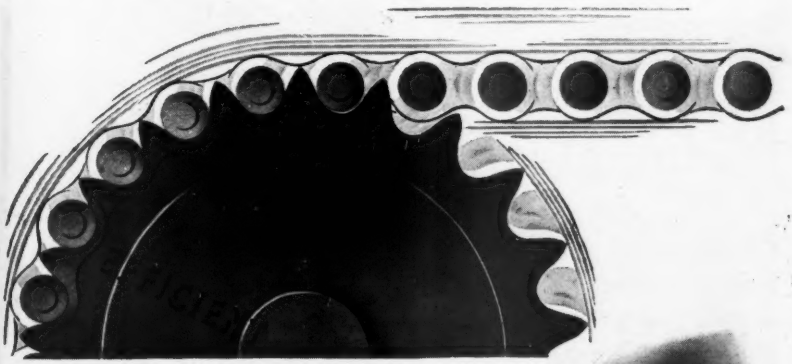

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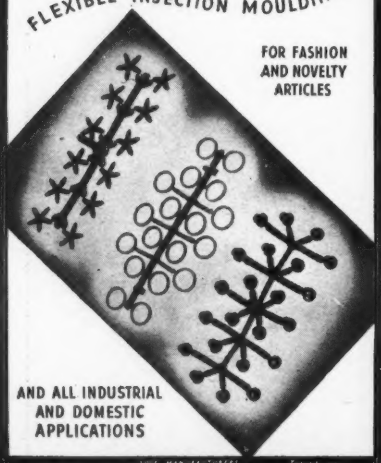

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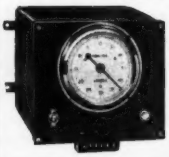

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Perspex Off-cuts, clear and coloured, cut to required size, lactoid rods and all forms of scrap plastic material; immediate delivery. Write, Plastic Department, J. E. Hoare, Byton Chambers, Amen Corner, S.W.17. zzz-399

Wanted, plastic waste and plastic piece goods. Send particulars, stating quantity and price. Box 6695, care of " Plastics." zzz-400

Perspex sheets or offcuts required, in clear or colours, any thickness up to ⅜ in. Universal Brush Co., Ltd., Luton, Beds. zzz-407

Perspex. We are stockists of I.C.I. Perspex. Try us for your requirements of clear and coloured sheets. Cuprex, Ltd., 1-3 Robert Street, Strand, W.C.2. Temple Bar 0902. zzz-405

Urgently required, black acetate sheet .080 in., transparent ruby .030 in. Particulars to Central Engineers, Ltd., 120 Old Street, E.C.1. Phone, Cle 2586. 120-9544

P.V.C. plastic sheetings, 18 ins. by 20 ins. by 2 mm., in various colours and embossed patterns. Supply ex stock. Also ¼-in. beltings. J. Shepperton and Co., Ltd., 161 Drummond St., W.1. 120-9543

Perspex. Considerable quantities of aircraft scrap Perspex will become available during the next 12 months. Further details on application. Box 7222, care of " Plastics." 120-9738

Production Capacity Available and Wanted (contd.)

Engraved name plates, scales, dials, etc., supplied. Tickets and Co., Box 2, Silver Street, Leicester. 129-9541

Urea moulding powder urgently required in pastel shades for export. Send fullest details to Box 7230, care of " Plastics." 121-9757

We have immediate capacity for design of all types plastic moulds and can assist in placing them for manufacture. Write or phone, The Lion Design Service Co., Ltd., 4 Castelnau, Barnes, S.W.13. Riverside 7771. 120-9735

Rod—Casein or Catelin rod required in ½ in. or ⅝ in. diameter. Substantial regular quantities needed, any colours considered. Write in first instance to Box 7302, care of " Plastics." 121-9734

Metal powders and oxides. Quotations and samples on application. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-410

W. Page and Sons,
34 Langside Crescent, Southgate, N.14. Phone, Palmers Green 5087.
The following lines always in stock:—
Wooden boxes, 18 by 12 by 9, at 2s. 6d. each; 21 by 12 by 9 at 2s. each. With lids.
12 by 12 by 12 Australian butter boxes at 1s. 4d. each.
Large tea chests at 5s. 9d. each. Small tea chests at 4s. 6d. each.
Export cases in ½-in. timber all round, 30 by 17 by 14, at 12s. 6d. each.
Cartons. Large, medium assorted cartons sold mixed in approximately the following sizes:—20 by 12 by 12, 19 by 13 by 15, 21 by 14 by 13, 23 by 13 by 10½, 13 by 10 by 21, etc., etc.
5,000 lots and over at 1s. 3d. each. Under 5,000 at 1s. 4d. each. 30,000 in stock.
Small mixed cartons. Sizes range from 17 by 12 by 6 to 8 by 5 by 5, approximately. To-day's cheapest carton at 6d. each.
Thousands of others in stock. We would welcome your inquiries, which shall receive our prompt and courteous attention.
All goods free delivered in the London area, f.o.r. elsewhere. zzz-421

Perspex for sale. New sheets, offcuts, large and small scrap; clear and colours in various thicknesses. Box 7676, care of " Plastics." 121-398

Direct inquiries invited, home and export market, for moulded combs and Perspex fancy goods. Box 7691, care of " Plastics." 121-396

Wanted, plastic articles of every description for export and British Isles. Representatives active in all parts. Can place large orders for export. Write N. Gerver, Plastic Dept., 2-10 Mare Street, Hackney, London, E.8. 131-394

Wanted, plastic sheeting in all thicknesses from 1-16-in. to 1-in. Can place large orders for home and export markets. Please submit samples and prices to N. Gerver, 2-10 Mare Street, Hackney, London, E.8. 125-393

Work wanted, tool room available for all sorts of press tools. Press work, assembling, spraying and all sorts of engineering to your design. Universal Components, Ltd., 19 Sunderland Terrace, W.2. Bay 6776. 131-392

Beautiful plastic bracelets, made with nickel-plated loops interwoven with plastic in attractive colours; selling at 5s. and upwards, £1 per dozen, post free. Sample, 2s. 6d. Reynolds, 16 Wensley Street, Blackburn, Lancs. 120-41

P.V.C. ½-in. Belting in all metallic colours supplied from stock. Box 7513, care of " Plastics." 120-x898

Capacity for wood pattern and model making. Let us quote you. Birchfield Pattern Works, Ketley Town, Wellington, Shropshire. 120-x1441

Engraving. Name plates, signs, clock faces, instrument panel instructions, etc., supplied in plain or decorative laminated sheet. Apply, Geometric Co., Birch Street, Wolverhampton. 120-x1804

The Superb Stamping Co. Stamping in genuine gold " Krome " and colours for volume production. Acetates, Phenolics, wood, leather products where trade marks, wording and ornamentation required. 84 Highbury Park, London, N.5. Canonbury 1915. 122-x2323

3-oz. Injection Moulding Capacity available; own raw material supplied. Box 7983, care of " Plastics." 120-x2511

Cellulose acetate scrap urgently required; best prices paid. Write, Cuprex, Ltd., Finsbury Pavement House, 120 Moorgate, London, E.C.2. Phone, Metro. 9641-5. zzz-424

We are able to undertake certain short or long runs of highly specialized medical and technical plastic moulded products. Injection, compression or sheet fabrication. Use our services for the preparation of prototypes. All inquiries strictly confidential. Box 7678, care of " Plastics." zzz-422

Production Capacity Available and Wanted (contd.)

Capacity available for finishing all types of plastic mouldings; trimming, drilling, polishing, assembly, etc. Box 8059, care of "Plastics." 122-401

Perspex. Large stocks, all thicknesses, available, particularly 1-16-in. and ¼-in., coloured. Write for price and stock list. Almex, Ltd., Exchange Buildings, Stephenson Place, Birmingham, 2. 122-399

Casein sheets wanted, all thicknesses. Box 8066, care of "Plastics." 120-38

Perspex wanted, ¼-in. and ⅜-in., dense opal. Box 8065, care of "Plastics." 120-37

Injection moulding capacity available, 1½-2 oz.; preferably customer's mould and material. Box 8061, care of "Plastics." 120-33

For sale: 20,000 pairs industrial canvas mittens, ex-Government stock, quick-release wrist fasteners, suitable heavy work, gardening, etc., 4s. 6d. dozen pairs; carriage paid on six dozen or over.

Two tons Perspex scrap, 4 mm., good condition, crystal and amber; all good-sized pieces 2s. to 3s. lb., according to quantity and sizes taken. Minimum order 14 lb. 10,000 ft. green and tan plastic belting, ribbed both sides, 1¼-in. wide, 3½d. ft.

15 cwt. 3 mm. acetate sheets, 57 by 25 ins., at 6s. lb. Plastic sheets, 8 ft. by 4 ft. by ⅛ in. or 1/16 in., brown finish or cream faced, from 1s. 4½d. sq. ft.

D. H. Ridout and Son, Ltd. Reg. office: 12 Stedman Road, Southbourne, Bournemouth. Phone, Southbourne 505. 120-25

Wanted, clear Perspex sheets about ⅛-in. thick, suitable for cutting into panels 13 ins. by 5 ins.; alternatively cut panels of this size, with or without finished edges. Offers to C. H. Davis, 38a Brompton Road, London, S.W.3. Kensington 4201. 120-22

Urea, phenol, acetate, polystyrene moulding powders available. Apply for details to Dunbee, Ltd., 10 Union Court, Old Broad Street, London, E.C.2. Phone, London Wall 2298. 120-21

P.V.C. sheeting, excellent quality, 36-in. wide material available in considerable quantities, wide range of colours, samples on application. Box 7680, care of "Plastics." 120-19

Injection moulding, small domed bases required in large or small quantities for scientific football game. Measurements and full details supplied to manufacturer who has capacity available for their injection moulding. P. A. Adolph, Langton Green, Tunbridge Wells, Kent. 120-16

Mould making, engraving, die-sinking, capacity for injection and compression mouldings available. Nicoria, Ltd., 205 Endsleigh Court, Upper Woburn Place, London, W.C.1. Euston 5270. 120-12

Perspex off-cuts available, large pieces, ex-aircraft scrap, 2s. lb. Box 7689, care of "Plastics." 120-5

Injection moulding capacity available for long runs. 1½ oz. We supply powder. Customer's mould preferred. Finishing capacity. Box 8086, care of "Plastics." 120-48

Injection moulding materials available for home market (C.A., P.V.C., Polythene), tons lots. Write box 7688, care of "Plastics." 120-4

Capacity available for plastic advertisement display figures or similar moulded articles to any design. Allbright Electric Co., Ltd., King's Grove, Maidenhead. 120-47

SITUATIONS VACANT

Shorthand Typists, Private Secretaries, Clerks, etc. If you are in urgent need of staff, contact Embassy Secretarial Employment Bureau, Excel House, Whitcomb Street, W.C.2. Whitehall 5924. We specialize in efficient personnel. 124-8069

Chief chemist for electrical industry. Should be fully conversant with all types of varnishes used for insulation, bonding and mica products. Box 7305, care of "Plastics." 120-9736

Plastics. Chief draughtsman required by a large Midland firm of plastic moulders. Applicant must have modern machine-shop experience. Applications should be accompanied with details of experience, recommendations and salary required. Box 7679, care of "Plastics." 120-2

Charge hand required for moulding shop; experience of hydraulic maintenance, thermosetting and thermoplastic processes essential. Write, with full details, to Box 7683, care of "Plastics." 120-3

Yorkshire chemical manufacturers require organic research and development chemist, age 22-30, with University Degree, preferably in colour chemistry. Candidates having A.R.I.C. or equivalent qualifications will be considered. Salary according to age and experience. Superannuation scheme in operation. Box 7690, care of "Plastics." 120-6

Situations Vacant (contd.)

PLASTIC OR RUBBER WORKERS.

The largest plastic manufacturing company in Australia, employing over 500 hands, desires to contact men thoroughly experienced in plastic or rubber, who desire to emigrate to Australia.

Numerous staff positions, as foremen and sub-foremen, exist for capable, reliable men accustomed to supervising, age not exceeding 45 years, having the above experience, particularly relating to the following:—

COMPRESSION MOULDING.
INJECTION MOULDING.
MILLING.
EXTRUDING.
CALENDERING.
SPREADING.

An executive of the company will visit England about the end of June, 1947, and will personally interview applicants.

The company is prepared to give assistance in obtaining passage to Australia.

Applications in writing, giving full particulars of age, education, practical experience, and personal details of family, etc., to Box 8058, care of "Plastics." 120-32

Foreman plastic moulder required for compression transfer and injection plant, N.W.9 area. Able to control labour and production. Give details of experience, etc., to Box 7692, care of "Plastics." 120-7

Estimating and planning engineer, fully experienced, capable of working on own initiative from drawings. Only those with good experience in stamping, moulding and machining laminated and thermo-plastic materials need apply. State age, experience and salary required. North London district. Box 8057, care of "Plastics." 120-31

Applications invited for position of works manager for plastic factory on Tyneside, to engage in production of vinyl sheeting and coating, calendering, embossing, etc.; similar experience essential; also a background for developing new works. Applicants must submit full particulars of past experience, age and qualifications, all of which will be treated in strict confidence, to Box 8060, care of "Plastics." 121-400

Required, research chemist with specialized knowledge of rubber and plastics, by a firm specializing in these products. Applicants should have a good Honours Degree in Chemistry and suitable industrial experience. The selected candidate will be expected to co-operate closely with the local technical college, where courses are being organized for the employees of the firm, and will be expected to undertake part-time teaching at the College in the Chemistry of Rubber and Plastics. Applications to H. Heathcoat, Mining and Technical College, Church Street, Barnsley. 120-x2900

Highly skilled man required to take charge of injection moulding department in London area. Box 8090, care of "Plastics." 120-x3002

SITUATIONS WANTED

Laminated Plastics. Insulation engineer, A.I.E.E., M.Inst.B.E., 16 years' experience plant, materials, processes, testing and research, seeks progressive, responsible post. Available August. Present post technical manager. Box 6984, care of "Plastics." 120-x9354

Plastics technologist, qualified, with sound background in chemical and metallurgical engineering, also draughtsman, available. Production and fabrication experience. Knowledge in designing and making moulds by means of electrolytic deposition. Write, stating in which field of plastics interested, to Box 8064, care of "Plastics." 120-36

Junior draughtsman, wide experience plastics mould design, National Certificate, requires progressive position Birmingham district. Box 7923, care of "Plastics." 120-x2355

Ex-gunner officer (25), studying for intermediate B.Sc. and taking course in plastics technology by correspondence, finding concentrated theory heavy going after six years of war, would welcome opportunity in the plastics industry to show general ability and willingness to learn. Very interested in design, and has concrete ideas on the possibilities of plastics in yacht and small craft design. Box 7811, care of "Plastics." 120-x1797

Plastics technician (33) with first-class experience in manufacture of mouldings by compression (powder and laminates), transfer and injection methods, knowledge sheet forming acetate and Perspex; expert mould designer and sound, practical engineer; present salary £750. Box 7490, care of "Plastics." 120-x814

Experienced works manager desires similar position; full charge of compression and injection moulding plant, tool design, estimating and costing. Box 7473, care of "Plastics." 120-x759

TIME RECORDERS

Factory time recorders. Service rental. Phone, Vigilant 4731. Time Recorder Supply and Maintenance Co., 157-159 Borough High Street, S.E.1. 125-8459

VALUATIONS

PROCEDURE IN RESPECT INCOME TAX CONCESSIONS—DEFERRED REPAIRS. MARTIN WOOD, SON AND PARTNERS, The Valuers, of 81 High Holborn, W.C.1. Phone, Hol 4485. SCHEDULES OF BUILDINGS—MANUFACTURING PROPERTY, PLANT REGISTERS, DETAILED INVENTORIES COVERING INSURANCE AND TAX CLAIMS. WE SPECIALIZE PRECISION MACHINERY. 122-391

WANTED

Scrap plastic material wanted, any quantity. Perspex, Lactoid, Catalin, Acetate, Bakelite, Presspahn. Write, Plastics Dept., J. E. Hoare, Byton Chambers, Amen Corner, Tooting, S.W.17. 124-404

Scrap. Why not let a well-established firm quote you for cellulose acetate, polystyrene, P.V.C. cuttings and other thermo-plastic off-cuts and scrap? Having best use for these materials, highest prices can be paid. Quotations on receipt of representative samples to M. H. Grist (Plastics), Ltd., 82-84 Brighton Road, Surbiton, Surrey. Phone, Elmbridge 4214. zzz-395

Urea formaldehyde and cellulose acetate moulding powders in miscellaneous colours; regular supplies required Apply British Technical Plastics, Ltd., Mason Avenue, Whitley Bay, Northumberland. 120-x723

Plastic fabricators invite ideas, suggestions or assignments for productions of plastic products. Box 7472 care of "Plastics." 120-x709

Wanted, qualified engineers, etc., to write courses on plastics and general engineering, etc., for correspondence college. Authors have opportunity to become widely known, and will be paid substantial royalties on all students who take their courses. Write T.C.C., 40 Worcester Road, Blackburn, Lancs. 120-x1100

Plastic cloth (P.V.C. sheeting) in various thicknesses, for manufacturing raincoats, required by London export company with large overseas organization; orders in hand. Box 8063, care of "Plastics." 120-x2881

Wanted, urea, scarab, phenol powders; any quantities, large or small; top prices paid. Box 7421, care of "Plastics." 122-x557

Regular supplies of paper-covered Perspex, coloured or clear off-cuts, large or small; lots of new Perspex sheeting; acetate suitable for lampshades, and any other material suitable for occupational therapy work. Plastics-Hobbies and Modelcraft, 12a West Laith Gate, Doncaster. 121-397

Celluloid sheets or offcuts in 20-60/000 in. thick, in transparent or opaque, urgently required for manufacturing purposes. Box 6899, care of "Plastics." 122-9545

Phenol and urea moulding material urgently required. Box 7686, care of "Plastics." 120-42

Wanted for cash, corrugated Perspex sheets, all sizes; crystal and black acetate sheets, all gauges; sheet plastics of all types. Quantities and prices to D. H. Ridout and Son, Ltd., registered office, 12 Stedman Road, Southbourne, Bournemouth. Phone, Southbourne 505. 120-26

MISCELLANEOUS

Photography by Behr will show your product at its best. Ask for illustrated list. 44 Temple Fortune Lane, London, N.W.11. Speedwell 4298. 121-9072

Monomarks. Permanent London address. Letters redirected, 5s. p.a. Write, Monomarks, BCM/MONO76, W.C.1. 122-9353

Ebonite and bakelite always in stock. Phone, Archway 3654. A. E. Goodeve, Ltd., 188a Seven Sisters Road, London, N.7. 121-9075

For immediate delivery. Plastic denture bowls with lids, three colours, price 10s. per dozen, plus purchase tax. Particulars: The Mayfair Export and Import Co., 3 Grosvenor Gardens, London, S.W.1. Phone, Victoria 6974. 120-x418

For sale ex-stock cellulose acetate and polystyrene injection moulding compounds. Box 8077, care of "Plastics." 120-46

For export only, 2,350 yds. yellow P.V.C. sheeting, 53 ins. wide, .0079 in. thick. Spooled and packed at 2s. 6d. per yard, f.o.b. Box 8067, care of "Plastics." 120-29

For sale constantly, cut-offs of ⅛ and 1/16 in. natural Holoplast, from 1s. per lb., according to size of pieces. Larks Spraying Process, Monument Hill, Weybridge. 120-43

Plastic boards, 1/16 in., specially treated, highest artistic finish, suitable for panelling, furniture, bath, splashbacks, etc.; plain colours or marble effect, and wood (oak, mahogany, walnut, etc.), sheets 8 by 4 or cut to requirements. Prompt deliveries. Larks Spraying Process, Monument Hill, Weybridge. 120-44

Extend Your Trade.
Use a Trade Mark. Consult
Trade Mark Protection Society.
12 Church Street, Liverpool. 130-9745

Plastics Designers. Components, moulds and tools planned, designed and drawn. Alex S. Godfrey, 64a Clapham High Street, S.W.4. 121-395

Blister Hangars, 91-ft. span by 45-ft. long, and other sizes. Steel or asbestos roofing, open or closed ends. Suitable for repair shops, factories, storage, etc. Details from J. Thorn and Sons, Ltd., Box 115, Brampton Road, Bexleyheath, Kent. Phone, Bexleyheath 305. zzz-423

Drawings prepared by experienced draughtsman. Original designs undertaken. Write for estimates. Box 7717, care of "Plastics." 120-x1527

Improve sales by decorative hand painting. Contract or individual work undertaken. Samples returned promptly. Edwards, 48 West Hill Street, Brighton. Phone, Brighton 8815. 120-x2385

Acetate sheets (.010 thick), 17 ins. by 14 ins., and other sizes. G. Foster, 90 Maida Vale, London, W.9. Maida Vale 7787. 120-x1990

Decorating of Plastics and Metals by engraving or colour. Expert craftsmen. Quick service. Samples executed free. Apply, Box 7810, care of "Plastics." 120-x1787

Complete Hair Slide Mould, eight impressions, new and unused, for sale. Prompt delivery. Martins, 17 Trafalgar Street East, Bury New Road, Manchester, 8. 120-x965

Button Dies and Plastic Moulds. Quick delivery. Martin, 17 Trafalgar Street East, Bury New Road, Manchester, 8. 120-x965

For sale, 1 ton new large off-cuts 40-thou. cellulose acetate, 4s. 9d. per lb. Also ½-ton 70-thou. sheets, 3 ft by 1 ft. 6 ins., cellulose acetate, 5s. 6d. per lb. All plastic materials urgently required. London's largest plastic dealers. Victor Laurence and Co., 10 D'Arblay Street, Wardour Street, W.1. Gerrard 8793. 120-x3021

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